To my loving parents
Kyriacos and Constantia Loizidou

Value Stream Mapping at Marks & Spencer Cyprus

By

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ABSTRACT

Value Stream Mapping is a lean technique with origins from manufacturing environments and specifically from the factories of the automobile manufacturer Toyota. However, considerable work has been done by researchers to transform the terminology drawn from a manufacturing environment in order to fit other environments. This project is based on this transformation so that Value Stream Mapping can be used in the warehouse, service and office environments of Voici La Mode Ltd. A product family was chosen and by following the flow of products and flow of information through a specific value stream selected, the current state was mapped. The wastes within the value stream were identified with the use of a set of mapping tools and through the future map suggested, the possible ways to eliminate these wastes were provided.

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I. INTRODUCTION

The globalization of markets, the increase in customer's expectations, cost pressures and environmental responsibility are some of the factors that drive many companies to become lean. Organizations that declare quality, value, service, innovation and trust as their unchanged values are more committed to their customers and such values can be achieved and sustained with the lean philosophy. An organization with such declared values is Marks and Spencer which has franchises in more than 30 countries. One of these franchises is Marks & Spencer in Cyprus, otherwise known in operations as Cyprus 2 Account of Voici La Mode Group of Companies.

1.1 Statement of the problem

Voici La Mode Group of Companies started its operations in Cyprus with the company Voici La Mode Ltd in 1959 as a franchisee partner of Marks & Spencer UK. Voici La Mode Ltd now operates 6 Marks and Spencer stores in Nicosia's district, which is the capital of Cyprus. The stores are: the Acropolis, Makariou, Latsia, Home store and Lakatamia. The sixth store named Onasagorou, was added in the Group at the end of this project as an outlet store. The Group also owns Café La Mode Ltd, which is a company with three restaurants in Nicosia, and two CELIO stores in Nicosia, which are

French menswear clothing franchises of Francium Enterprises. At the moment, the total work-force of the Group is over 250 employees.

The author visited the Group for a period of one week and during his stay there he conducted several meetings with the Logistics Manager and the Commercial Manager. The author also visited the two Distribution Centers and the Headquarters of the Group and collected primary qualitative and quantitative data. A first analysis of those data showed inefficiencies not only in the flow of products but also in the flow of information. Specifically, inefficiencies were spotted in the way that orders were placed from the Group's Headquarters in Cyprus to M&S UK, in the processing of products in the two Distribution Centers and in the communication between Hemel (Consolidation Center in UK) and the Logistics Manager. These data and the statements of the employees proved that further investigation was needed.

Since the problem of Cyprus 2 Account is not only one but actually a variety of wastes in the flow of products and flow of information it has been decided that the lean technique named as Value Stream Mapping would be implemented in order to provide an insight on the current situation. The product family chosen for investigation in this technique is the fashion apparel-hanging type because it goes

through all the processes in the supply chain and is a very difficult product family to handle due to the rapid change in fashion trends.

1.2 Research objectives

With the implementation of Value Stream Mapping, the current state should be mapped, which shows the "AS IS" state and afterwards the future state map must be created which is the "TO BE" state. In order to achieve this, the mapper must follow the flow of the product family chosen and the flow of information within the selected value stream. The mapping must be conducted only in key processes using a set of mapping tools. Therefore the following objectives are specified for this project:

- **Understand, map** and **identify wastes in** the products and information flow:
    - **Within Hemel International** related to Cyprus 2 Account.
    - **Within the Distribution Center** in Cyprus where the fashion apparel-hanging type is stored.
    - **Within the M & S stores in Cyprus** where the fashion apparel-hanging type is stored.
    - Between **Hemel International** and the **main Distribution Center** of M&S Cyprus 2 Account.

- Between the main **Distribution Center** and the **4 M&S stores** of Cyprus 2 Account.

- Examine the **order acquisition process** between the **Headquarters of Voici La Mode LTD** and **M&S UK** and **identify any wastes** in this process.

- Examine the **order fulfillment process**, covering all the activities:
  - **From** the moment the products arrive to **Hemel until the products reach to the main Distribution Center in Cyprus.**

  - **From** the moment the products arrive to **the main Distribution Center in Cyprus until they reach the M & S stores.**

- Identify and examine the **nature and purpose of information flows** between key stakeholders and decision makers within the Group.

- Understand and analyze **the impact of wastes** on the Group's business operations.

The purpose of this project is not to provide the optimal solutions for improving efficiency, due to the short time available for this research, but to reveal the gabs for improvement. It is expected that questions for discussion will be raised through the use of the mapping tools that hopefully will lead, in the future, in the seek for the best correction measures.

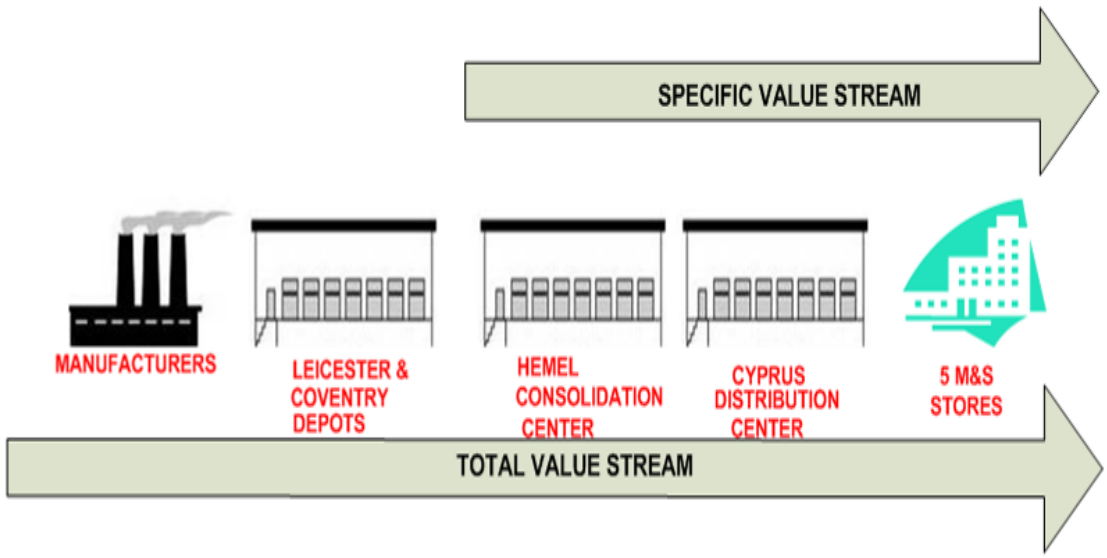
1.3 Assumptions

Taking into consideration that Voici La Mode Ltd is a franchisee, it is expected that there is a limited set of activities that Cyprus 2 Account can actually have control of. In addition, considering the fact that Cyprus 2 Account is a small Account, in comparison with the other Accounts of Marks & Spencer, the power of influence over the franchisor's decisions is also limited. Therefore, it has been decided that this technique will be implemented only in areas where improvements can actually be made so that this project will be useful for Voici La Mode Ltd and all parties involved.

Specifically, in this project, the value stream selected for implementing the Value Stream Mapping technique is the part of the supply chain from Hemel-Consolidation Center in UK up to the 6 stores of Marks & Spencer in Cyprus. The value stream selected can be seen in Figure 1. Only the one of the two Distribution Centers in

Cyprus and the 4 of the 5 stores will be examined where the flow of the product family under investigation passes through. The sixth store was not investigated because it opened at the end of this research. However, the impacts of this addition to the company and to this project were taken into consideration. The Order Fulfillment process was split into two parts of order fulfillments for the flow of products and flow of information: (a) from Hemel to Cyprus Distribution Center and (b) from Cyprus Distribution Center to the 4 M & S stores.

Figure No. 1. The specific value stream under investigation.



Last, the main analysis in this project was conducted in Cyprus while the Consolidation Center in UK was examined in order to

understand how it affects Cyprus 2 Account and to find any available solutions in the gabs that were found.

1.4 Challenges

During this dissertation the following challenges were faced by the author:

- All the employees of the company in Cyprus and the employees in the Consolidation Center in UK except the Logistics Manager of the Group were unfamiliar with the Value Stream Mapping technique.
- The author had no previous knowledge of this specific lean technique.
- The implementation of this technique in environments other than manufacturing was difficult due to the manufacturing origins of Value Stream Mapping.
- The geographical boundaries made difficult the collection of further data from the UK since it was impossible to travel back to the UK once the main analysis in Cyprus had started.
- During the month of July the Group had its stock counting and as a result for two weeks all employees were unavailable to be interviewed.
- During the month of August it was difficult for the employees to devote time for interviews and to provide data because:
    - They were taking their vacation leaves.

  - They were busy with the preparations for the new M & S store.
- The collection of quantitative data in UK and Cyprus was difficult because the data were not available in a form suitable for analysis and sometimes they did not exist.
- The mapping of information flow with this technique was difficult and sometimes not possible.
- The implementation of the Value Stream Mapping technique was very time consuming.

1.5 Outline

In Chapter 2 the history of lean thinking is presented together with the lean principles as introduced by Womack & Jones (2003). Then, the different wastes not only from manufacturing but also from warehouse and service environments are explained. Some lean tools/techniques and philosophies are also explained with a greater focus on Value Stream Mapping (VSM). Therefore, the implementation of VSM technique is described in detail together with its benefits and drawbacks.

In Chapter 3, the research methodology which was designed and used in this project is presented including all the steps which were needed to reach the specified objectives.

In Chapter 4, the operations of Voici La Mode Ltd are described in order to provide to the reader useful information so that the current state will be comprehensive.

In Chapter 5, the current state within the selected value stream is presented. A series of prerequisite steps before mapping the current state are also illustrated. These steps include a SWOT analysis, an identification of the value and the core activities and a selection of VSM mapping tools.

In Chapter 6, the future state map is presented without the wastes identified in the current state together with some suggestions within 1 month, in the short, medium and long term.

In Chapter 7, a comparison of the written literature for the VSM technique with its actual implementation in this project is presented. Moreover, some conclusions related to the results derived from this project are also shown.

II. LITERATURE REVIEW

2.1 Origins of Lean Thinking

The lean concept started many years back and specifically after World War II by Toyota. At that time, Japan was decimated by two atom bombs, most industries had been vanished, the supply base was nil and the consumers had limited amount of money. Even before World War II Toyota was facing great challenges as its auto line produced 900 units in comparison with Ford who produced 9000 in the USA. Moreover, Ford was 10 times more productive than Toyota (Liker, 2004). In order to understand Ford's mass production system, Edji Toyoda, the chairman of Toyota Motor Manufacturing, went for a tour in 1950 to the USA and to Ford's River Rouge Complex. Surprisingly, Edji Toyoda and his managers observed many inherent flaws such as huge amount of inventory waiting in different steps of different processes (Womack et al, 2007).

This evaluation showed to Toyota an opportunity to catch up and therefore an assignment to improve Toyota's manufacturing process was given to the company's chief engineer Taiichi Ohno. Specifically, Ohno used Ford's original idea of continuous flow to develop a system of one-piece flow but which could change

according to customer demand and would be efficient at the same time (Liker, 2004). Ohno's efforts created the Toyota Production System (TPS), which basically aimed at minimizing the consumption of resources that did not add any value to the product. According to Womack & Jones (2003), any human activity that absorbs resources and creates no value is considered as waste or "muda", as the Japanese call it. Toyota's chief engineer Taiichi Ohno identified within the Toyota Production System (TPS) the first seven wastes: 1) overproduction, 2) waiting, 3) transportation, 4) inappropriate processing, 5) unnecessary inventory, 6) unnecessary motion and 7) defects (Jones et al, 1997). The term "lean" was introduced in Krafcik (1988) to refer to a manufacturing approach that compared to mass production it uses less of everything-half the human effort in the factory, half the manufacturing space, half the investment in tools, half the engineering hours to develop a new product in half the time (Papadopoulou & Ozbayrak, 2005).

Since then, many approaches have been performed in order to transform the terminology drawn from a manufacturing environment in order to fit other environments (Hines et al, 2000). Considerable work to achieve this is being done at the Lean Enterprise Research Centre in Cardiff, the implementation of Supplier Association into a range of UK-based industry sectors by Hines and the translation of the Toyota Production System

philosophy into a warehouse environment by Jones (Hines et al, 2000).

2.2 Lean Principles

The 5 lean principles were introduced by Womack & Jones (2003) and as stated by Bicheno (2004) some managers are upset with these principles as they believe that they are not feasible within their industry. Nevertheless, Bicheno states "But this is to miss the point, which is vision: you may not get there within your lifetime, but try-others certainly will" (2004, p.10).

2.2.1 Value

As Womack & Jones state "Value can only be defined by the ultimate customer. And it's only meaningful when expressed in terms of a specific product (a good or service and often both at once) which meets the customers needs at a specific price at a specific time" (2003, p.16). According to Pawar et al (1993), the value is divided into two types which are the ***use*** and ***esteem*** or ***status.*** First, the *use* is the sum of the elements of value which affirm that the necessary function or functions will be performed. Second, *esteem* or *status* is the sum of elements of value which are related with non-functional features. Hines et al (2002), define the *use* and *esteem* or *status* as value attributes and specifically they

state that the *use* includes tangible elements such as product features, quality and delivery times. On the contrary, esteem or status includes more intangible elements such as service and relationships.

2.2.2 The Value Stream

A value stream is all of the activities required to develop a specific product or service from concept to launch and from order to delivery and includes three types of activities: 1) *value adding*, 2) *necessary but non-value adding* and 3) *non-value adding* (Ferro et al, 2004). In a physical product environment, manufacturing or logistics flow, the ratio between these three types are 5% value adding activities, 35% necessary but non-value adding and 60% non-value adding (Hines & Taylor, 2000).

The first set of activities involves those that actually create value as perceived by the customer. On the contrary, the second category is named as "Type One muda" and includes those activities that create no value but are required in the product development, order filling or production systems (Womack & Jones, 2003). Some examples of these include walking long distances to pick up items, unpacking deliveries and transferring tools and their elimination would require major changes to the operating system such as creating a new

layout (Hines & Rich, 1997). The third category, named "Type Two muda", are those activities that create no value as perceived by the ultimate customer and therefore should be eliminated immediately (Womack & Jones, 2003). Some examples would include waiting time, stacking intermediate products and double handling (Hines & Rich, 1997).

2.2.3 Flow

According to Womack & Jones (2003), after the value has been specified and the wastes removed within the mapped value stream, then is time for the remaining value adding activities to flow. The general trend is to group activities by type in order to be performed more efficiently and managed more easily. Womack & Jones (2003), present this general thinking that seems more logical in an interesting experiment performed with their daughters, ages six and nine. Their daughters were asked the best way to fold, address, seal, stamp, and mail the monthly issue of their mother's newsletter. Their reply was: "Daddy, first, you should fold all of the newsletters. Then you should put on all the address labels. Then you should attach the seal to stick the upper and lower parts together. Then you should put on the stamps". However, this thinking of processing is not efficient and unfortunately, as Womack

& Jones (2003) observed, this thinking is common in the world, not just within six and nine year-olds.

Henry Ford and his associates were the first who understood the potentials of flow and by implementing continuous flow in the final assembly of the Model T Ford they achieved 90 percent reduction on the amount of effort. Ford lined up all the machines producing the parts for Model T and tried to achieve flow from raw materials to shipment of the finished car. Nevertheless, he discovered that this method only worked in high production volumes to justify high-speed assembly lines, when there was uniformity on the parts used for every product and when the same product was produced for many years (Womack & Jones, 2003). The real challenge was to achieve a continuous flow in small-lot production which was not accomplished until after World War II by Taiichi Ohno and his technical associates. This was successful with quick changes over tools from one product to another and by "right sizing" machines so that processing steps of different types such as molding, painting and assembly could be conducted immediately adjacent to each other with the object being manufactured kept in continuous flow (Womack & Jones, 2003).

In spite of this dramatically discovery, the great bulk of activities across the world are still conducted in departmentalized, batch-and-queue fashion. The basic problem is that flow thinking is

counterintuitive as it seems obvious to most people that work should be organized by departments in batches. Employees try hard to switch over to flow only when they have departments and specialized equipment ready for making batches at high speed (Womack & Jones, 2003). On the contrary, the lean approach is to redefine the work of functions, departments and firms in order to make a positive contribution to the creation of value and understand the real needs of employees at every point along the stream (Womack & Jones, 2003).

2.2.4 Pull

According to Ferro et al (2004), *pull* is a method of control in which downstream activities signal their needs to upstream activities. The purpose of *pull* is to eliminate excess inventory and is one of the three major components of a complete just-in-time production system.

The conversion from departments and batches to product teams and flow result in the first visible effects which are dramatic time reductions in the stream from concept to launch, sale to delivery and raw material to the customer. Specifically, the product development can be reduced by 50 percent, the order processing by 75 percent and by 90 percent in physical production (Womack &

Jones, 2003). The pull of products in a continuous flow is considered as a revolutionary accomplishment as the ability to design, schedule and make exactly what the customer wants just when the customer wants it means the sales forecasts are not needed. As a result, the demands of the customers become more stable when they know what they want and producers stop pushing products which no one wants (Womack & Jones, 2003).

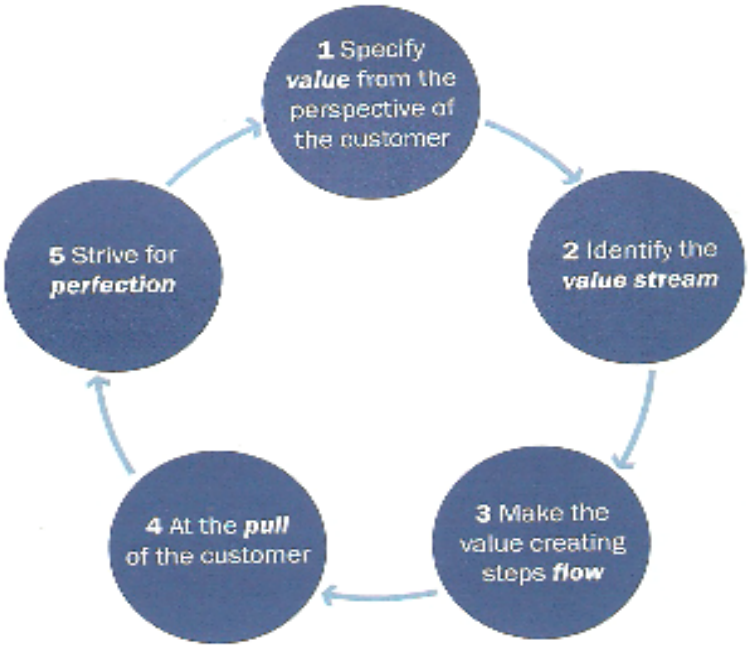
2.2.5 Perfection

Perfection is the fifth principle that will come naturally after the firms specify first *value*, identify the entire *value stream*, make the value-creating steps for specific products *flow* continuously and let customers *pull* value from the organization. After the implementation of the four principles, the employees will realize that there is no end once they start reducing effort, time, space, cost and mistakes (Womack & Jones, 2003).

The concept of perfection will follow after the correct implementation of the first four principles because these principles interact with each other in a virtuous circle as it can be seen in Figure 2. Making value to flow faster always reveals hidden *muda* in the value stream. Pulling harder though, results in the exposure of more obstacles to flow in order to be removed (Womack & Jones,

2003). Last, dedicated product teams who are in direct contact with customers can always discover ways to specify value with more accuracy and often learn of ways to improve flow and pull as well (Womack & Jones, 2003).

Figure No 2. The 5 Lean Principles



Source: Hines et al (2008): Staying Lean. Thriving, not just surviving

2.3 The different wastes

The first wastes where identified by Toyota's chief engineer Taiichi Ohno within the manufacturing environment. However, through the passing of time different researchers have translated Ohno's wastes into warehouse and service environments and

presented some new wastes as well. The following are the different wastes with a short description and examples.

According to Bicheno (2004), an easy way to remember Ohno's 7 wastes is by asking "who is **TIM WOOD**?". Hines & Rich (1997), state the following 7 wastes:

1. **T**ransport: This waste involves goods being moved about and considering as an extreme any movement in the factory could be viewed as waste. Therefore, the aim is to minimize it if not to totally remove it.

2. **I**nventory: This waste is related to unnecessary inventory which tends to increase lead time, storage costs preventing quick identification of problems and increasing space, thus discouraging communication.

3. **M**otion: This waste involves the ergonomics of production where operators have to stretch, bend and pick up when these actions could be avoided. These unnecessary movements make employees feeling tired and as a result is likely to lead to poor productivity and quality problems.

4. **W**aiting: This waste is related to both goods and workers and specifically whenever goods are not moving or being worked and when workers spend time waiting in a factory. This

waiting time could be used for training, maintenance or kaizen activities.

5. **O**verproduction: This waste is regarded as the most serious waste as it makes difficult the smooth flow of goods or services and is likely to inhibit quality and productivity. Moreover, overproduction leads to excessive work-in-progress stocks which result in the physical misplacement of operations with consequent poorer communication. This situation described above is often encouraged by bonus systems that encourage the push of unwanted goods.

6. **O**ver-processing or inappropriate processing: This waste appears when overly complex solutions are found to simple procedures such as using a large inflexible machine instead of several flexible ones. Generally, the over-complexity discourages ownership and encourages the employees to overproduce to recover the large investment in the complex machines. Such an approach encourages poor layout, leading to excessive transport and poor communication.

7. **D**efects: This waste is associated with direct costs and according to the Toyota philosophy any defect should be regarded as opportunities to improve rather than something to be traded off against what is ultimately poor management.

Therefore, defects should be dealt with immediate kaizen activity.

Hines et al (2000) state that the Toyota Motor Corporation has modified the above wastes for application to their parts distribution operations. These new modified wastes are the following:

1. doing things faster than the necessary pace, creating piles of inventory awaiting transportation to the customer and creating 'peaks' in the work load of employees;
2. unnecessary waiting as materials are not available or obstructed from picking;
3. unnecessary motion and searching for products;
4. conveyance;
5. inappropriate processing;
6. correction routines;
7. unnecessary inventory;

Bicheno (2004), states the following new wastes which can be added to Ohno's original list and are appropriate in service and manufacturing:

1. The waste of making the Wrong Product Efficiently: This is a restatement of the first Lean Principle and it is Womack and Jones's eighth waste.

2. The waste of Untapped Human Potential: This waste is directly related to Ohno who said that the objective of the Toyota Productive System was "to create thinking people".

3. The waste of Inappropriate Systems: This is related to the quantity of software in computers never being used, the quantity of record keeping, checking, reconciling that is pure waste.

4. Wasted Energy and Water: This refers to energy in terms of power source such as oil, coal and so on. Even if energy management systems in factory, office and home have grown there is still the human, common sense element. That is shutting down the machine, switching off the light, fixing the drip, insulating the roof, taking a full load, efficient routing, and the like.

5. Wasted Materials: This is based on the need of environmental responsibility and the profitability that started from the conservation of materials. To reduce materials waste, a life cycle approach is needed in order to conserve them during design, manufacturing, customer usage, and beyond customer use in recovery and remanufacturing.

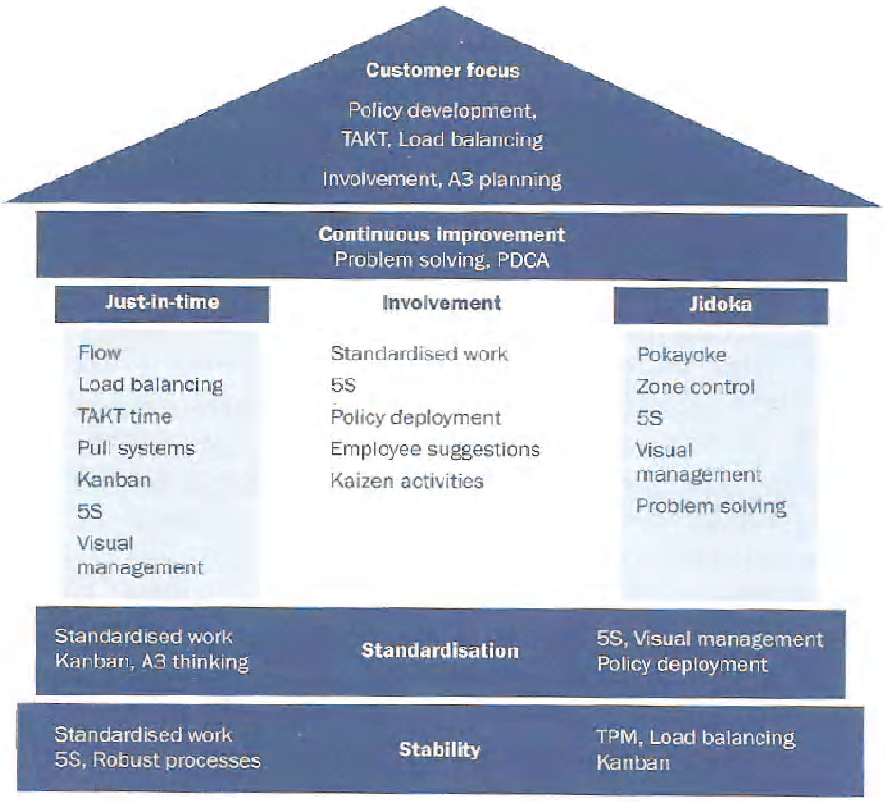
Moreover, Bicheno (2004), states another 7 wastes purely from the service environment, from customer's perspective, in contrast with the previous wastes which are seen from the organizations perspective. These are the following:

1. Delay on the part of customers waiting for service, for delivery, in queues, for response, not arriving as promised which results of course to lost sales.
2. Duplication due to re-entering of data, repetition of details on forms, copying of information across, answering queries from several sources within the same organization.
3. Unnecessary Movement due to queuing several times, lack of one-stop and poor ergonomics in the service encounter.
4. Unclear Communication which leads to the wastes of seeking clarification, confusion over product or service use, wasting time finding a location that may result in misuse or duplication.
5. Incorrect Inventory which basically is the out-of-stock when there is inability to get exactly what was required either this is substitute products or services.
6. Opportunity lost to retain or win customers, failure to establish rapport, ignoring customers, unfriendliness, and rudeness.
7. Errors in the service transaction, product defects in the product-service bundle, lost or damaged goods.

2.4 Lean Tools/ Techniques and Philosophies

Lean tools are the means to building, sustaining and improving the Lean System (Husby, 2007). As it can be seen from Figure 3, a set of lean tools/techniques and philosophies construct the Toyota Production System, or "House" as presented by Ferro et al (2004). Afterwards, a number of these tools/techniques and philosophies such as the 5S, Total Productive Maintenance (TPM), SMED, Kaizen, and Just-in-time are illustrated and explained.

Figure No. 3. The Toyota Production System "House"



Adapted from *Andy & Me: Crisis and Transformation on the Lean Journey* by Pascal Dennis

2.4.1 The 5S

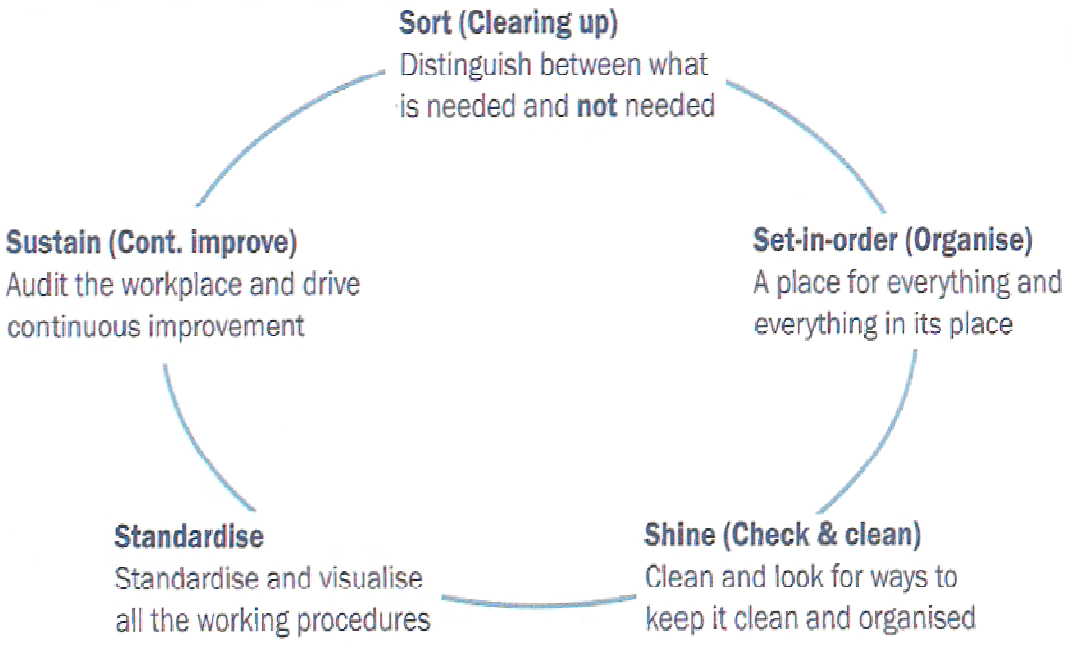
The original concept of 5S was developed by Takashi Osada in the early 1980s and the Toyota Production System provides (TPS) a well-known example of 5S principles in practice (Gapp et al, 2008). 5-S is the acronym for the five Japanese words *Seiri, Seiton, Seiso, Seiketsu* and *Shitsuke* which when translated these words literally mean "organisation", "neatness", "cleanliness", "standardisation" and "discipline" respectively (Warwood et al, 2004). As Hines et al state "5S is often a platform approach starting a Lean Implementation. It involves and empowers employees and it has huge visual impact. It also releases capital and space held in holding obsolete stock and equipment." (2008, p. 69).

The implementation of *Seiri* (Organization) involves separating what is required from that which is not, eliminating those which are not required and or tidy them away. The *Seiton* (Neatness) involves arranging the required items in a tidy manner and in a clearly defined place, so that it can be accessed quickly (Ferro et al, 2004). With *Seiso* (Cleaning) the surrounding area and environment are kept clean and tidy while with *Seiketsu* (Standardization) the machinery and equipment are cleaned according to laid down standards and routine in order to identify deterioration. Last but not least, the *Shitsuke* (Discipline) involves having discipline to follow

the four previous steps and continuously improve them (Dale, 2003).

When understood and developed within the context regardless of the organisations size or type, 5S can be used to engage improvement activities within many environments including: homes, schools, communities and workplaces (De Mente, 1994). The 5S, also know as "housekeeping", has been recognized by many famous service companies such as McDonalds, Disneyland and Speedi-Lube for their critical nature (Chase et al, 2007).

Figure No. 4. The 5S

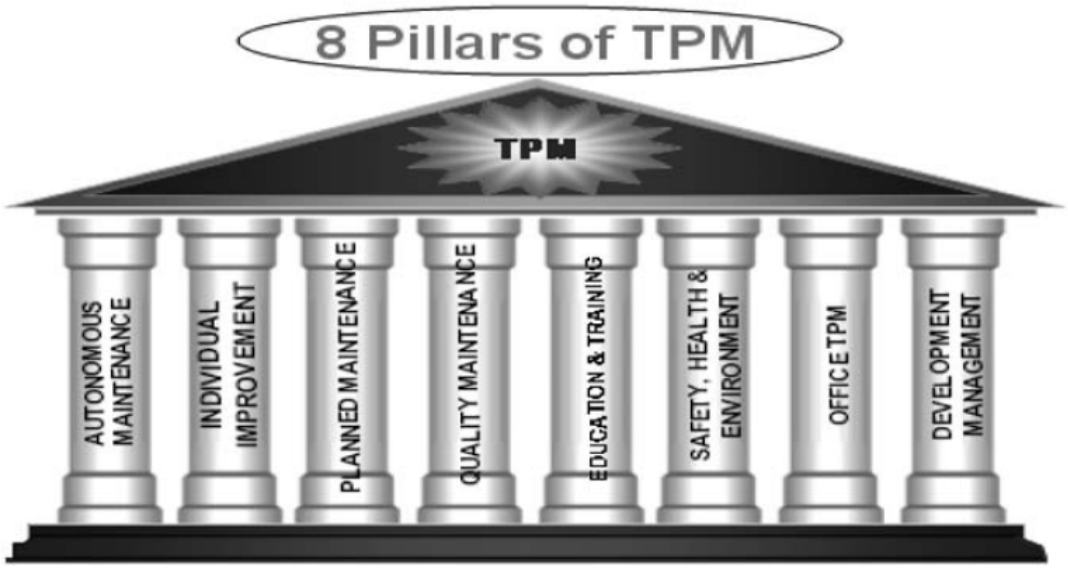


Source: Hines et al (2008): Staying Lean. Thriving, not just surviving.

2.4.2 Total Productive Maintenance (TPM)

Total Productive maintenance is a scientific, company-wide approach in which every employee is concerned about the maintenance, quality and efficiency of their equipment (Dale, 2003). TPM initiatives, as suggested by the Japan Institute of Plant Maintenance (JIPM), involve an eight pillar implementation plan that results in substantial increase in labour productivity through controlled maintenance, reduction in maintenance costs, and reduced production stoppages and downtimes (Ahuja & Khamba, 2007). The JIPM eight pillar TPM implementation plan is illustrated in Figure 5.

Figure No. 5. The 8 Pillars of TPM



Source: Ajuha and Khamba (2007): An evaluation of TPM implementation initiatives in an Indian manufacturing enterprise.

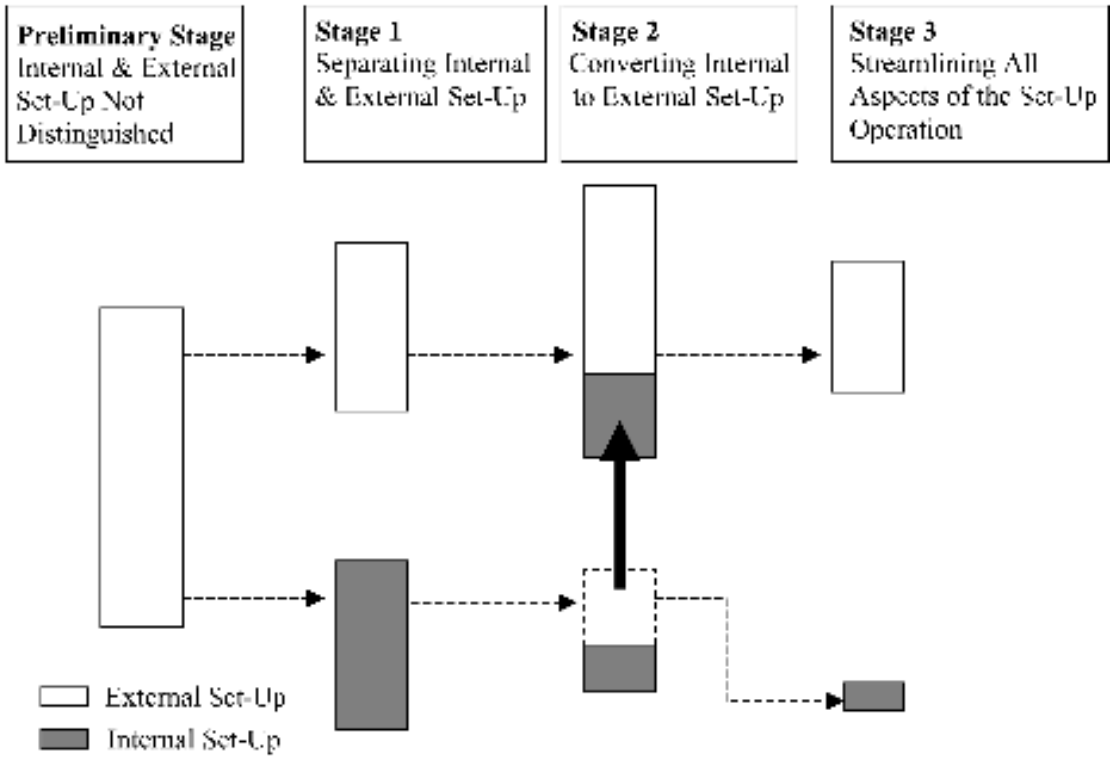
Some specific motives for the implementation of TPM are the improved productivity through a highly motivated workforce, the understanding of the life cycle approach for the improvement of the overall performance of equipment and the voluntary, small group activities, also known as zero defects groups, which make full use of everybody's skills (Bohoris et al, 1995). Although TPM is wrongly considered as a term that is related only to manufacturing and production, the concept applies as much to the office environment as it does to the shop floor (Hines et al, 2008). For example, computers and networks break down, causing availability issues.

2.4.3 Single Minute Exchange Die (SMED)

The single minute exchange of die (SMED) technique was developed by the quality Guru Shingo in a period of 19 years, beginning in 1950 (Patel et al, 2001). The term SMED refers to the theory and technique for performing set-up operations in less than 10 minutes and some of its benefits include stock reduction, productivity improvements, flexibility and reduction in set-up errors and defects (Dale, 2003). SMED theory states that, even if the frequency of the set-ups cannot be reduced, the actual downtime caused by machinery specification changes can be reduced significantly, thus providing an increase in available production capacity (Mohxam & Greatbanks, 2001). Shingo pronounces that SMED can be applied to

any factory and to any machine and the stages of implementation are illustrated in Figure 6.

Figure No 6. The stages of SMED



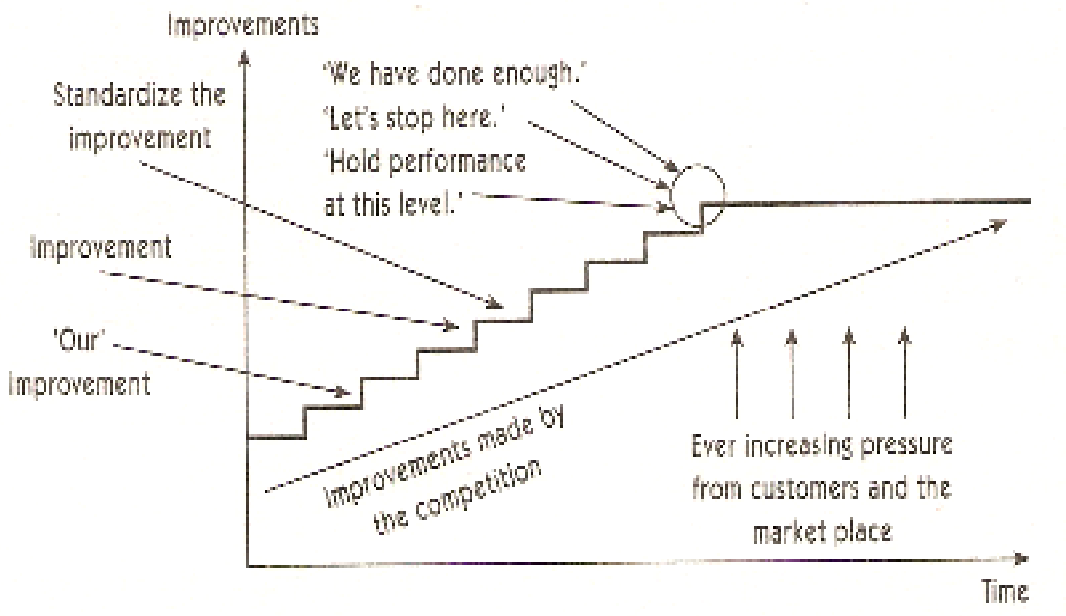
Source: Monham & Greatbanks (2001): Prerequisites for the implementation of the SMED Methodology. A study in a textile processing environment.

2.4.4 Kaizen

"Every day in every way I am getting better and better" was a slogan coined by the French psychotherapist Dr Emile Coué in the 1920s (Wittenberg, 1994, p.12). Kaizen is exactly what the above slogan states which is a philosophy of continuous improvement as a result of continuous effort. It is consider by many manufacturing managers like pushing a ball up all incline and inserting a wedge

into position to stop the ball from rolling back between each upward push (Brooks, 1993). This perception is illustrated in Figure 7.

Figure No 7. Continuous Improvement Perception



Adopted from Dale: Managing Quality

As it can be seen by Figure 7, standardization is an essential feature of kaizen and specifically a company must establish a standard, maintain it and then improve it. Standards could be a set of policies, rules, directives, and procedures formed by management for all major operations in order to enable all employees to enforce their tasks successfully (Wittenberg, 1994). Imai developed a kaizen approach for the waste in job shops environments which included not only standardization but also housekeeping and waste elimination (Rawabdeh, 2005).

In order to make Kaizen implementation quick and easy Bodek suggests participation from idea contributors, record of an idea in a simple way so that everyone can understand it and the sharing of an idea for people to read and discuss (Strategic Direction, 2003). Kaizen supports the TPS through the formal emphasis on teamwork, the improvement suggestion scheme and the "zero defects" group and quality circles. Furthermore, it is expected by employees to work with conscious awareness of the importance of quality assurance and quick problem solving (Elsey & Fujiwara, 2000).

2.4.5 Just–In-time (JIT)

The essential idea of JIT was originally developed by Toyota in Japan and basically this idea was formalised into a management system when the company wanted to meet the precise demand of customers for different models and colours with minimum delay (Sohal & Fouad, 1988). JIT is based on a pull system, thus nothing will be produced until there is a need from the downstream operation (Zhu & Meredith, 1995). From a narrow view it could be said that JIT is the production of small quantities, just-in-time, rather than the production of large quantities, just -in case. From a broader perspective, though, the aim is to continuously eliminate

waste and delay at every stage, from raw material to final customer and from concept to market (Fiedler et al, 1992).

Spencer et al state "JIT has generally been viewed as an inventory reduction technique which can be used to reduce continually the levels of inventory in a production process until stopped by some event. When this happens, the event is "attacked" and the barrier to further inventory reductions is removed." (1994, p. 60). Based on this interpretation some researchers argue that JIT warehousing is a contradiction since the existence of a warehouse it is an obstacle to achieving continued inventory reductions (Spencer et al, 1994). Nevertheless, a more appropriate view of JIT logistics' role is that it should increase deliveries of purchased components to the points of use and, ultimately, eliminate warehousing activities (Spencer et al, 1994).

The JIT philosophy includes the kanban system which is consisted of two cards: the *Requisition Kanban* which is used to authorise the movement of standard containers between work stations, and the *Production Kanban* which authorises the production of a standard container of parts at a work centre (Sohal & Fouad, 1988). Kanban is only one component of JIT and Figure 8 shows its different elements through a comparison from different researchers.

Figure No. 8. The elements of JIT

Element	Schonberger [3]	Hall [1]	Gilbert [11]	Mehra and Inman [14]	Crawford *et al.* [9]
1. Overall JIT philosophy	X	X	X	X	X
2. Optimum layout (GT)	X	X	X	X	X
3. Minimum set-ups	X	X	X	X	X
4. Minimum lead time	X	X	X	X	X
5. Cross-trained workers	X	X	X	X	X
6. Supplier involvement	X	X	X	X	X
7. Quality circles	X		X	X	X
8. Preventive maintenance		X	X	X	X
9. Total quality management	X	X	X		X
10. *Kanban* (trigger)		X	X		X
11. Linear MPS		X	X		X
12. Customer-driven rate	X	X	X		X
13. Mutual respect	X	X	X		
14. Standard operations	X	X	X		
15. *Jidoka*		X	X	X	
16. Limited supplier base	X		X	X	
17. Customer-driven products	X		X		
18. Supplier certification			X	X	
19. Reduce components	X		X		

Adopted from Spencer & Guide: An exploration of the components of JIT

2.4.6 Value Stream Mapping

Value stream mapping is a lean technique, initially developed in 1995, which helps researchers and practitioners to identify waste in individual value streams in order to remove it (Hines et al, 1998). It is a pencil and paper tool that helps its users to see and understand the flow of material and information as a product makes its way through the value stream (Rother & Shook, 1999). With Value Stream Mapping the objective is to create a value stream "map" of both product and information flow and identify the three categories

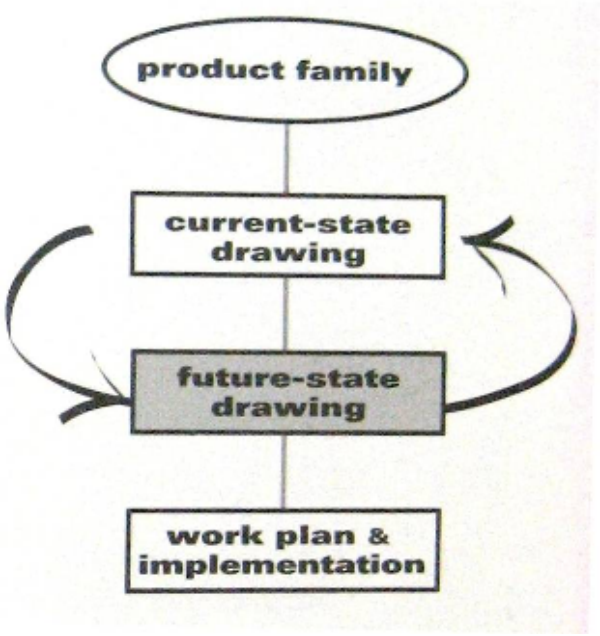
of activities already mentioned in section 2.2.2 (Womack & Jones, 2003).

Womack (2006) stresses the fact that it is critical for the mapper to walk the value stream from one end to the other so that the whole value stream is captured. Aft et al (2008), propose the need for a cross-functional team with members that represent all areas to be mapped. Furthermore, Rother & Shook (1999) emphasize the necessity of a person with lead responsibility for understanding a product family's value stream. This person is assigned as Value Stream Manager and he or she can help the mapper to get away from the isolated islands of functionality which appears in companies (Rother & Shook, 1999).

The mapping process can be achieved through a series of interviews to the people involved in a company's core activities, observations of activities and the use of a set of mapping tools developed for this technique (Hines & Rich, 1997). According to Rother & Shook 1999, Value Stream Mapping follows 4 steps:

1. Identify a product family.
2. Draw the current state.
3. Draw the future state.
4. Plan and implement the future state.

Figure No 9. The steps of Value Stream Mapping



Source: Rother & Shook (1999): Learning to see

As it can be seen from Figure 9, the arrows between current and future state map go both ways because the development of current and future states are overlapping efforts (Rother & Shook, 1999).

2.5 Product family

According to Schmeidler et al 2007, some products might not need all the steps in a process, thus a generic representative product can be chosen that will allow the implementer to follow the general sequence and optimize the flow. A key product line to a key customer and which is important to the company can be chosen in order to avoid confusion over the different routes adopted for different products (Hines & Taylor, 2000). Manos (2006), states

that every organization may have a different reason for selecting one product family over another when deciding which map to draw first. Some criteria of making this choice are the following:

- Largest reduction in lead time or inventory.
- Biggest impact to the customer.
- Most visible to the stakeholders.
- New product line.
- Volume or quantity.

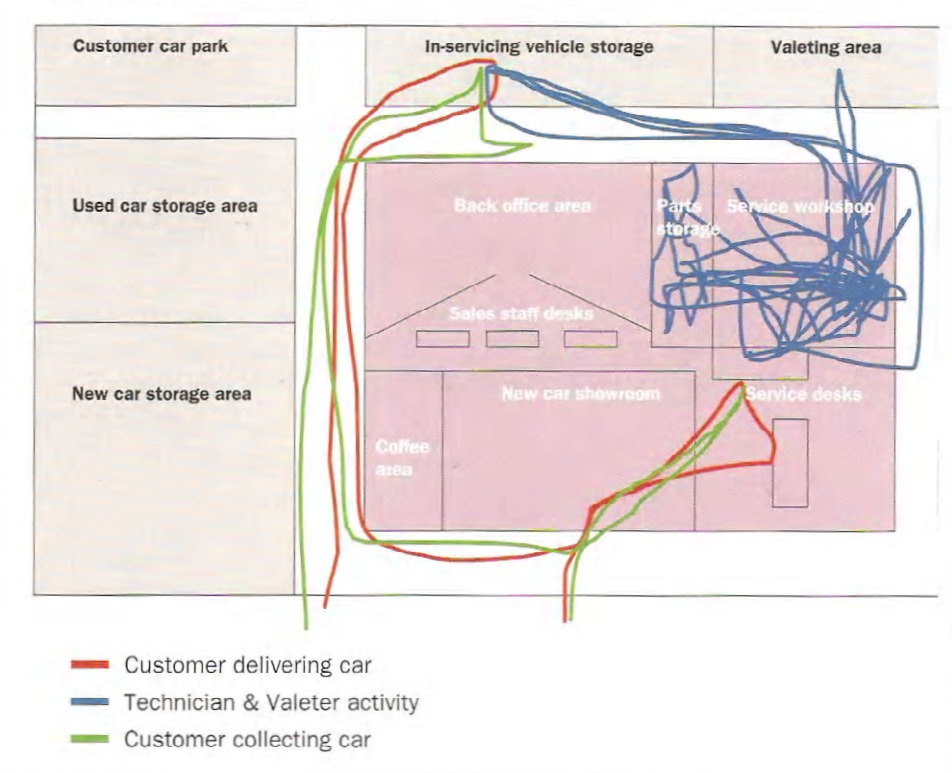
2.6 Current state mapping

A current state map illustrates how an organization's processes perform in today's work environment (Manos, 2006). However, before starting detailed mapping of any core process it is useful to develop an overview of the key features of that entire process (Hines & Taylor, 2000). Hines et al (2002) state that if the mapper does this it will help him/her to:

- visualize the flows,
- see where the waste is,
- pull together the lean thinking principles,
- decide who should be in the implementation teams,
- show relationships between information and physical flows, and
- create buy-in from the senior team undertaking the big picture mapping.

This can be done with the use of two tools; the "Spaghetti diagram" presented in Figure 10 and the "Big Picture Mapping" shown in Figure 11.

Figure No. 10. The spaghetti diagram

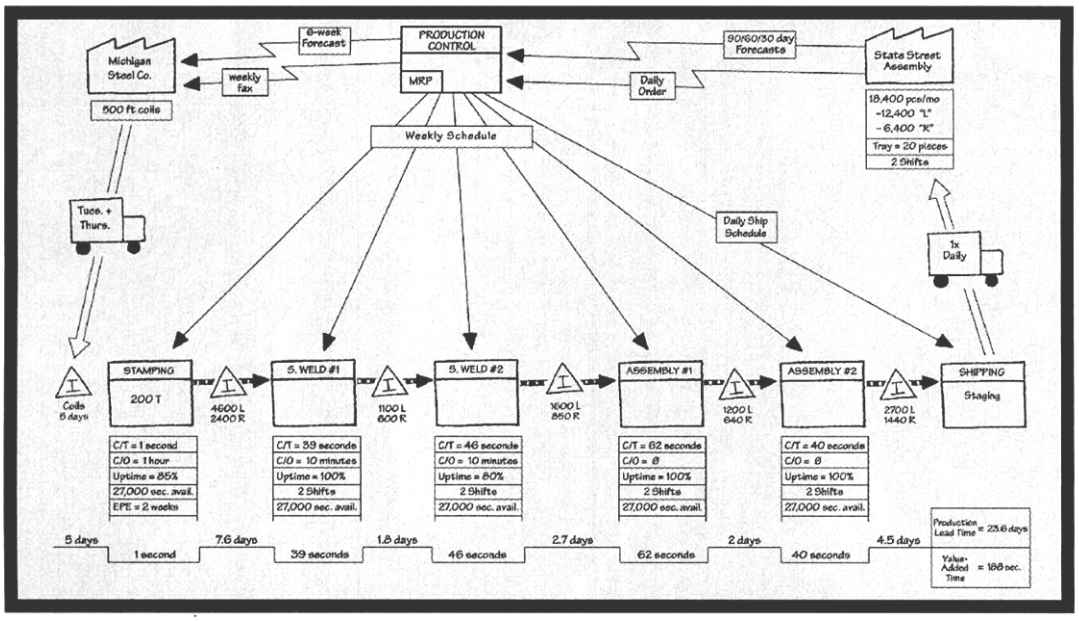


Source: Hines et al (2002): Lean Profit Potential

The spaghetti diagram is a tool that follows the flow of information and physical activity within a workplace environment. According to Hines et al (2002) it is helpful for identifying how wasteful movements can be minimized by process improvement and new layout and it can also be helpful in highlighting possible bottlenecks, where several value streams interact within a company.

The "Big Picture Mapping" looks just like a Value Stream Map, except that plants replace process stages. Moreover, information flows are in the top half while physical flows are in the bottom half (Bicheno, 2004). The "Big Picture Mapping" uses a standard set of icons, a sample of which is illustrated in Figure 12. These icons are categorized into *material flows icons*, *information flows icon*s and *general icons* and the whole set can be seen in Appendix 9.

Figure No 11. Big Picture Mapping of current state

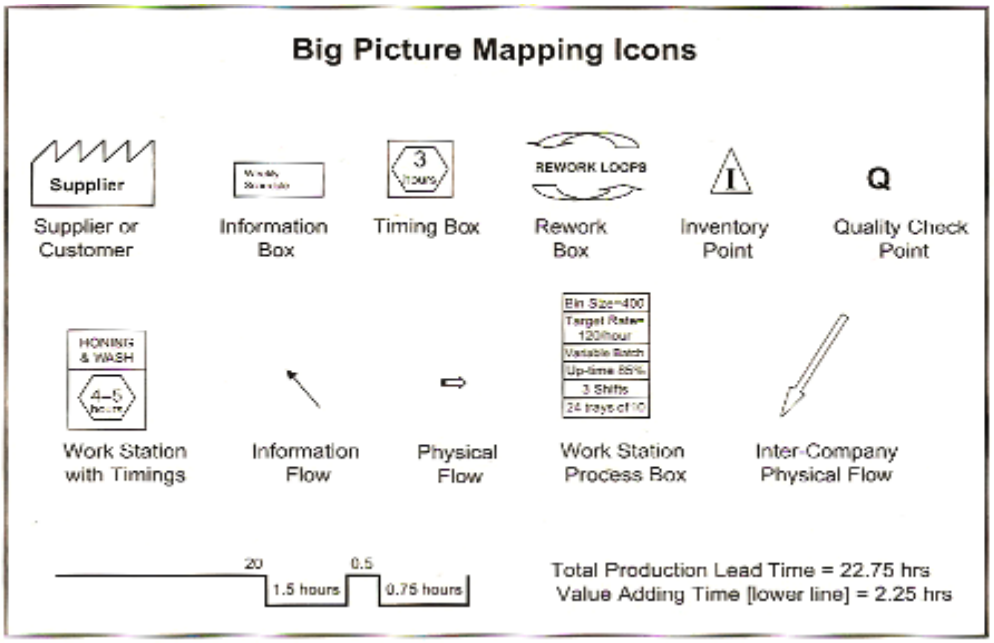


Source: Womack (2006): Value Stream Mapping

As it is shown in Figure 11, at the left top side the mapper places the supplier and at the right top side the customer. In the middle is the factory or warehouse connected with the information flow. At the bottom half, where is the flow of products, the amount of

inventory and valuable data such as the total production time and the value adding time can be recorded.

Figure No 12. Big Picture Mapping Icons

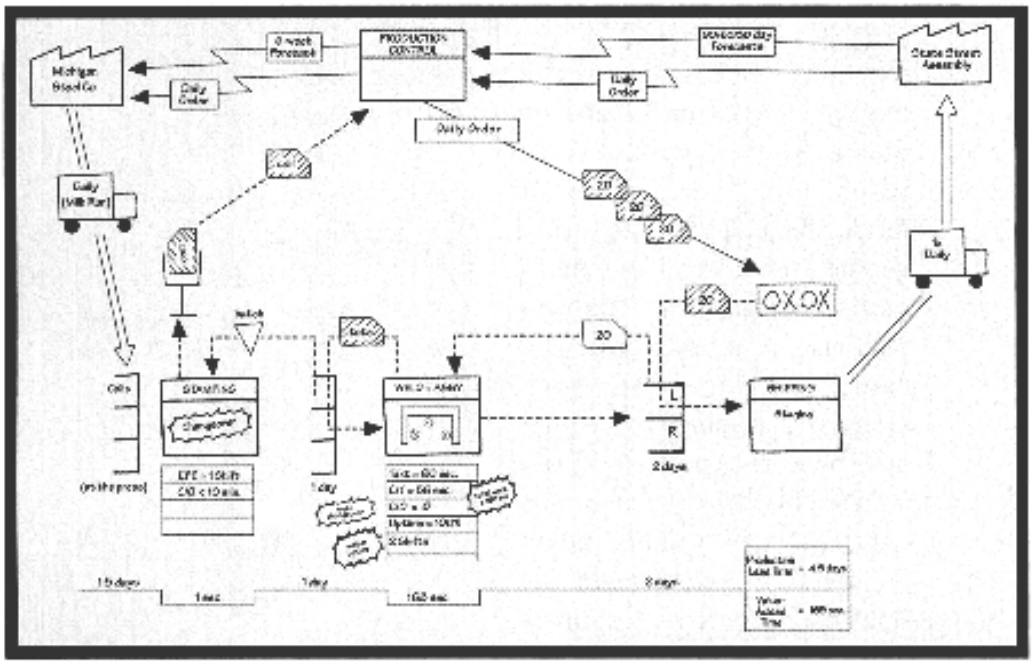


Source: Hines & Taylor (2000): Going Lean

2.7 Future state mapping

A future state map, shown in Figure 13 deploys the opportunities for improvement identified in the current-state map to achieve a higher level of performance at some future point (Ferro et al, 2004). According to Rother & Shook (1999), a future state map is so important that a current state map is not much use without it.

Figure No. 13. Big Picture Mapping of future state



Source: Womack (2006): Value Stream Mapping

Womack and Jones (2003) state that in order to create the future state map the following question need to be answered:

- What is the takt time for the chosen product family?
- Can the demand of the customer be met?
- Where can continuous flow be used?
- Will it be continuous flow until the shipping or be finished goods supermarkets?
- Where will the product need to use a pull system supermarket?
- What single point in the production chain (the pacemaker process) should the product be scheduled?

2.8 The Value Stream Mapping tools

After creating the big picture with a snapshot of the current state it is useful to use a number of detailed mapping tools to fill the gabs left by just looking at the big picture level (Hines et al, 2002). Hines & Rich (1997) present the initial 7 value stream mapping tools developed from different origins such as engineering, time compression/logistics, operations management, systems dynamics, and efficient consumer/logistics. These 7 mapping tools, together with another tool provided by Professor Peter Hines to the author, are explained in detail below.

2.8.1 Process Activity Mapping

This tool has its origins in industrial engineering and although is known by a number of names, Process Activity Mapping is the most common (Hines & Rich, 1997). Traditionally, it has been only used for the shop floor of manufacturing companies but it can be used more widely to identify lead time and productivity opportunities for both product flows and information flows (Hines et al, 2002).

According to Moinuddin et al (2007) this tool focuses on the following 5 process areas:

1. Flow of processes.
2. Waste identification.
3. Arrangements of activities in more efficient sequences.
4. Flow layout or transport routing for better flow patterns.
5. Elimination of superfluous tasks.

According to Hines & Rich (1997) Process Activity Mapping involves the following simple steps: First, a preliminary analysis of the process is conducted and all the items required in each process are recorded. Second, each step can be categorized into 4 activity types which are the operation, transport, inspection and storage or delay. According to Hines et al (2002) operations are value adding steps that someone is willing to pay for or a set rule; transports are where there is a movement but the company would prefer to avoid paying for this; inspections are checks of the quality and quantity of the product or information; delay (or storage) is where a product or information is waiting and there is no activity.

After the steps are defined, the machine or area used for each of these activities, the distance moved, time taken and number of people involved are recorded. Afterwards, the total distance

moved, time taken, and people involved can be calculated and recorded. These steps are illustrated in Figure 14. The analysis of the diagram that will be created and the available improvements can be achieved with the 5W1H technique (Why does an activity occur? Who does it? On which machine? When and How?).

Figure No. 14. Process Activity Map

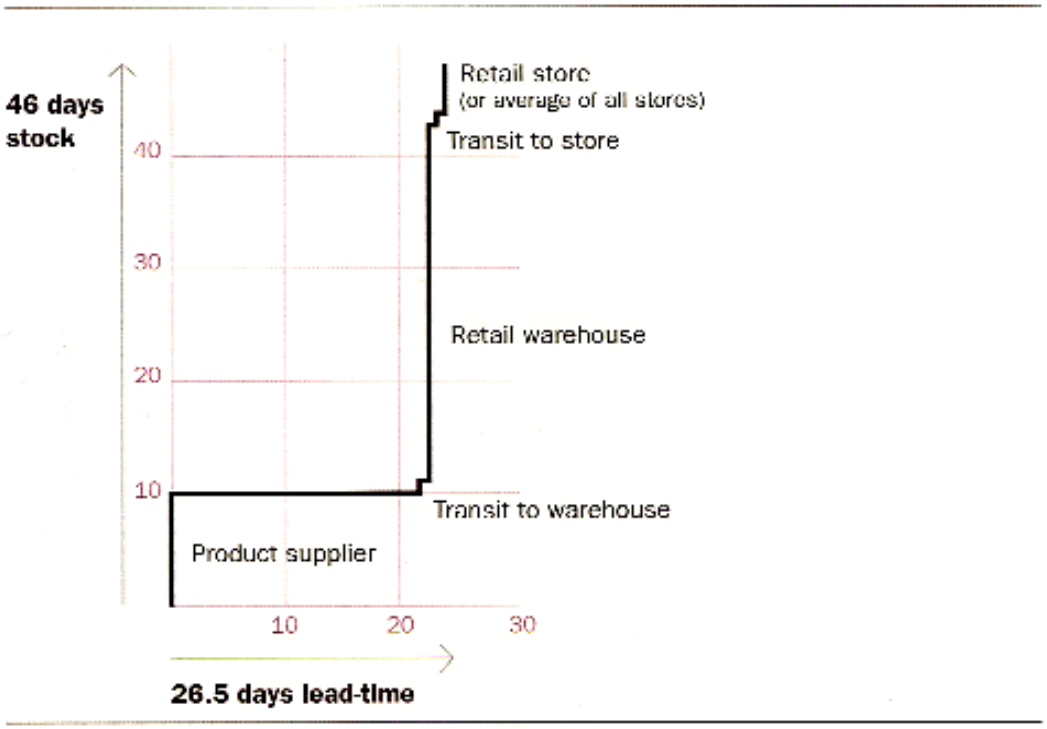
#	STEP	FLOW	AREA	DIST (M)	TIME (MIN)	PEOPLE	OPERATION	TRANSPORT	INSPECT	STORE	DELAY	COMMENTS
1	DRIVER TAKES PAPERWORK TO OFFICE	T	OUTSIDE/OFFICE	50M	0.5	1	O	T	I	S	D	
2	CHECK BOOKED IN/ISSUE TICKET	I	OFFICE	10	1	1(+1)	O	T	I	S	D	(DRIVER)
3	DRIVER TO VEHICLE	T	OFFICE/OUTSIDE	50M	0.5	1	O	T	I	S	D	
4	OPEN BACK OF TRUCK	O	OUTSIDE		1	1	O	T	I	S	D	
5	BACK ON TO BAY	T	OUTSIDE/BAY	30M	1	1	O	T	I	S	D	
6	WAIT FOR PUMP TRUCK	D	BAY		15	1	O	T	I	S	D	
7	UNLOAD LORRY	T	SPLITTING	25M	1	1(+1)	O	T	I	S	D	
8	WAIT FOR TOTAL UNLOADING	D	SPLITTING		20	2(+1)	O	T	I	S	D	10 PALLETS
9	WAIT FOR PAPERWORK	D	SPLITTING		10	(1)	O	T	I	S	D	DRIVER (TOTAL 30)
10	DRIVER TO OFFICE FOR PAPERWORK	T	OUTSIDE/OFFICE	20M	0.5	1	O	T	I	S	D	
11	GET PAPERWORK	I	OFFICE		3	1(+1)	O	T	I	S	D	
12	DELAY TO START SPLITTING	D	SPLITTING		120		O	T	I	S	D	
13	SPLITTING	O	SPLITTING		50	2	O	T	I	S	D	
14	MOVE PALLET TO QUANTIFICATION	T	QUANTIFICATION	20M	1	1	O	T	I	S	D	PUMP TRUCK
15	DELAY TO QUANTIFY	D	QUANTIFICATION		240		O	T	I	S	D	
16	QUANTIFY	I	QUANTIFICATION		10	1	O	T	I	S	D	
17	MOVE TO LIFT & LOAD	T	INSPECTION/LIFT	3M	2	1	O	T	I	S	D	
18	MOVE TO WIP	T	LIFT TO WIP	5M	0.3		O	T	I	S	D	
19	DELAY	D	LIFT TOP		5		O	T	I	S	D	
20	REMOVE FROM LIFT	T	LIFT TOP	2M	2	1	O	T	I	S	D	
21	PLACE IN STORAGE AREA	T	FLOOR	10M	1	1	O	T	I	S	D	
22	STORAGE	D	FLOOR		2880		O	T	I	S	D	
23	COLLECT PRODUCTION ORDER	T	TO OFFICE	25M	15	1	O	T	I	S	D	
24	PULL STOCK TO PRODUCTION AREA	T	TO PACKING	10M	2	1	O	T	I	S	D	HAND PUMP
25	DELAY	D	PACKING		15		O	T	I	S	D	SETUP
26	LOAD MACHINE & CYCLE	O	PACKING	2M	0.1	1	O	T	I	S	D	
27	PLACE IN TOTE	T	PACKING	0.5M	0.1	(1)	O	T	I	S	D	
28	WAIT FOR BATCH	D	PACKING		30		O	T	I	S	D	
29	LOAN CONVEYOR	T	PACKING TO CONVEYOR	12M	0.5	1	O	T	I	S	D	
30	TRAVEL TO CRANE	T	TO CRANE	150M	5		O	T	I	S	D	
31	WAIT FOR CRANE	D	CRANE		5		O	T	I	S	D	
32	PUT INTO MAIN STORE	T	CRANE/STORE	75M	1	1	O	T	I	S	D	
33	STORE	D	STORE		155,4 33.6		O	T	I	S	D	
	TOTAL			489.5 M	158,8 84.1	29						
	OPERATIONS				51.1	4						
	PERCENTAGE OPERATIONS				322 MPM	13.8%						

Source: Hines et al (1999): Value Stream Mapping. A distribution industry application

2.8.2 Supply chain response matrix

This tool has its origins in the time compression and logistics movement and has a variety of names (Hines & Rich, 1997). This mapping approach was first used by Jessop and Jones and seeks to portray in a simple diagram the critical lead-time constraints for a specific process (Seth et al, 2008). As it can be seen from the diagram in Figure 15 the horizontal axis shows the cumulative lead time for a product both internally and externally which is 26.5 days. The vertical axis shows the average amount of standing inventory in days at specific points in the supply chain which in this example are 46 days of stock. Thus, a total response time in this system of 72.5 working days can be seen to be typical. Once this can be identified, each of the individual lead times and inventory amounts can be targeted for improvement activity (Hines & Rich, 1997).

Figure No 15. The Supply Chain Response Matrix



Source: Hines & Taylor (2000): Going Lean

2.8.3 Production variety funnel

This approach originates in the operations management area and has been applied by New in the textile industry (Hines & Rich). According to Jones et al (1997), a similar method is IVAT analysis which views internal operations in companies as consisting of activities that conform to I,V,A, or T shapes as follows:

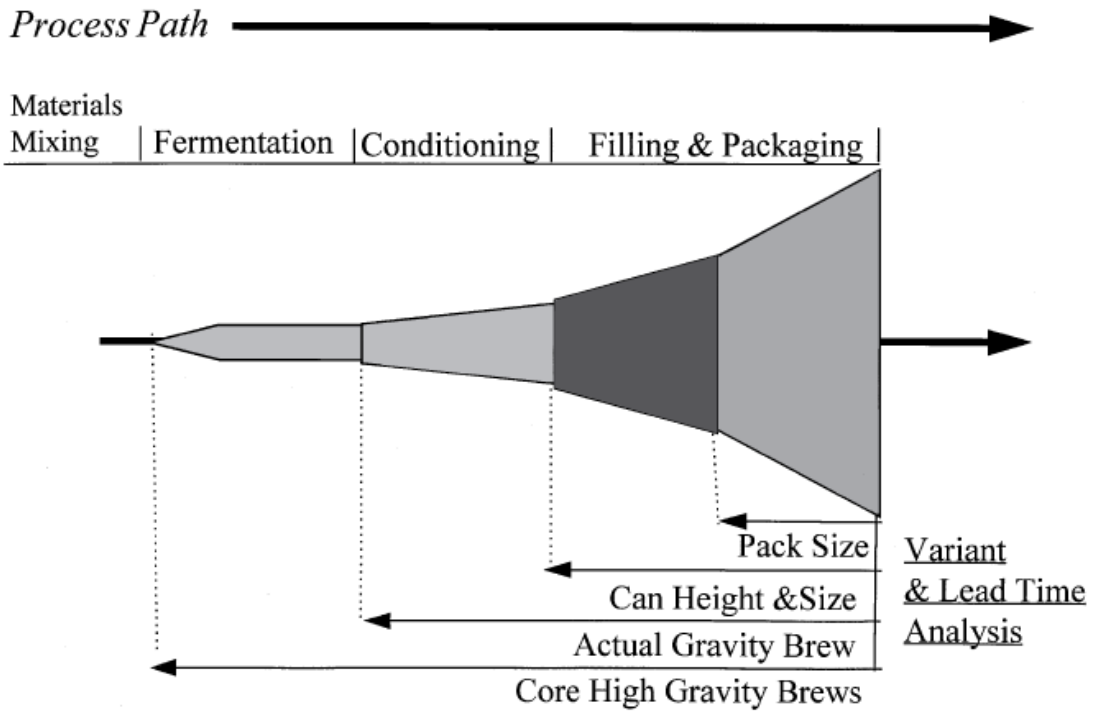
- "I" plants consist of unidirectional, unvarying production of multiple identical items such as a chemical plant.
- "V" plants consist of a limited number of raw materials processed into a wide variety of finished products in a

generally diverging pattern. "V" plants are typical in textile and metal fabrication industries.

- "A" plants, in contrast, have many raw materials and a limited range of finished products with different streams of raw materials using different facilities. Such plants are typical in the aerospace or other major assembly industries.
- Lastly, "T" plants have a wide combination of products from a restricted number of components made into semi-processed parts held ready for a wide range of customer-demanded final versions. This type of site is typical in electronics and household appliance industries.

Hines et al (2000) state that this tool allows the mapper to understand how the firm or the supply chain operates and how to manage the complexity that it is included. In addition, this tool is very useful when there is a need to reduce inventory and make changes to the processing of products. An example of a brewing industry case is presented in Figure 16.

Figure No. 16. The Production Variety Funel



Source: Hines & Rich (1997): The seven value stream mapping tools

2.8.4 Quality filter mapping

This is a new tool designed to identify where quality problems exist in the value stream (Jones et al, 1997). According to Hines & Taylor (2000) the resulting map itself shows the following three types of quality defect in the value stream:

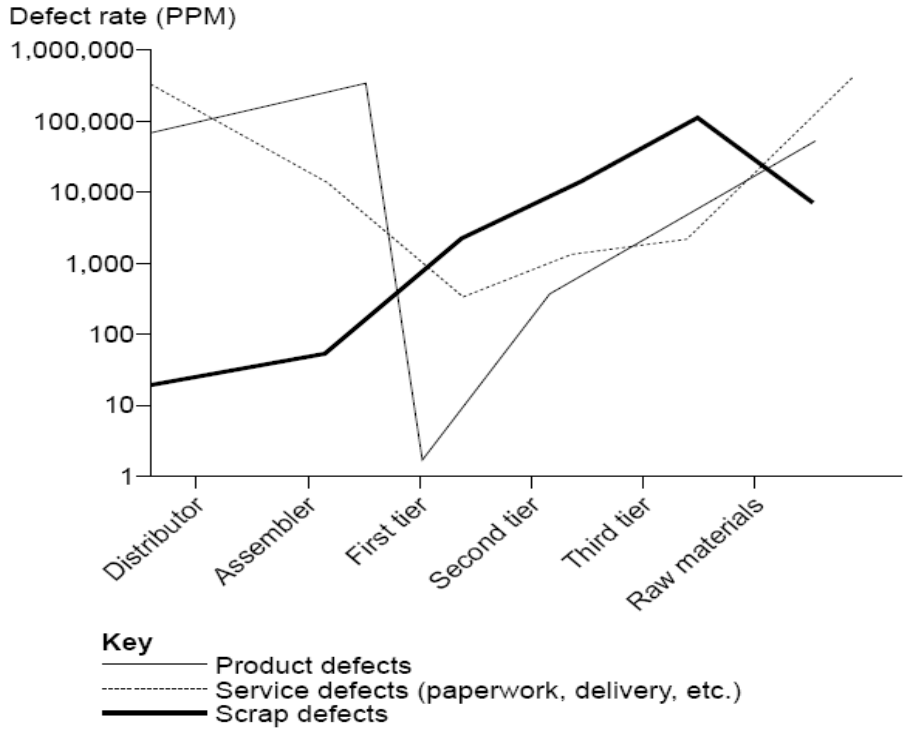
1. Product defect: Defects in physical goods that are not caught by in-line or end-of-line inspection and are therefore passed on to customers.
2. Service defect: These are problems given to a customer that are not directly related to the goods themselves, but

due to the accompanying level of service. The most important of these service defects is inappropriate delivery (late or early). Others include incorrect paperwork or documentation, incorrect packaging or labeling, incorrect quantity and incorrect invoicing.

3. Scrap defects: Defects that have been caught by in-line or end-of-line inspection. The in-line inspection methods will vary and can consist of traditional product inspection, statistical process control or through poke yoke devices.

In the horizontal axis of the automotive example provided in Figure 17, the different parts of the supply chain can be distinguished which are the distributor, the assembler, the 1st, 2nd and 3rd tier supplier and the raw materials source. On the vertical axis is the measurement unit which in this case is the defects Parts Per Million (PPM). Thus, a comparison between the different supply chain agents can be accomplished according to their defects rate.

Figure No 17. The Quality Filter Map



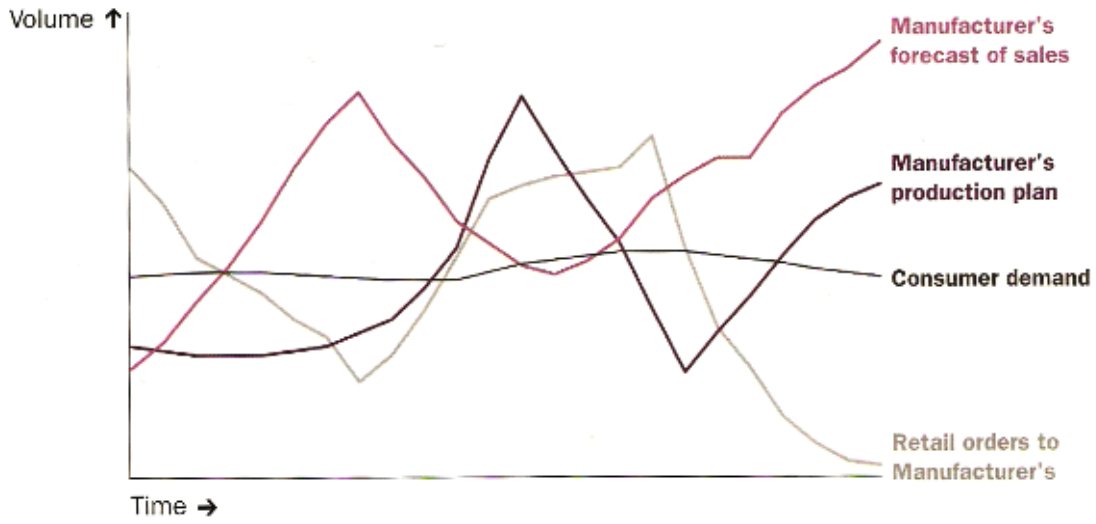
Source: Jones et al (1997): Lean Logistics

2.8.5 Demand amplification mapping

This tool has its roots in the systems dynamics work of Forrester and Burbidge and is related with what is known as "Forrester effect" which was first described in a Harvard Business Review article in 1958 (Hines & Rich, 1997). The Burbidge effect is linked to the "law of industrial dynamics" which states that if demand is transmitted along a series of inventories using stock control ordering, then the amplification of demand variation will increase with each transfer (Jones et al, 1997). The "Forrester" effect or otherwise known as "bullwhip", or "whiplash" or "whipsaw" effect was identified in

Procter & Gamble's replenishment patterns for the "Pampers" disposable diapers and in HP's sales of printers as well (Nahmias, 2005). In the example provided in Figure 18 it can be seen that the retail's orders to manufacturers and the manufacturers forecast of sales and production plan vary in comparison with the actual consumer demand.

Figure No 18. Demand amplification map



Source: Hines & Taylor (2000): Going Lean

Hines & Taylor (2000) propose that this tool should be used by the mapper to:

- See the extent of amplification as orders are passed upstream because the greater the amplification, the more difficult it is to encourage flow.

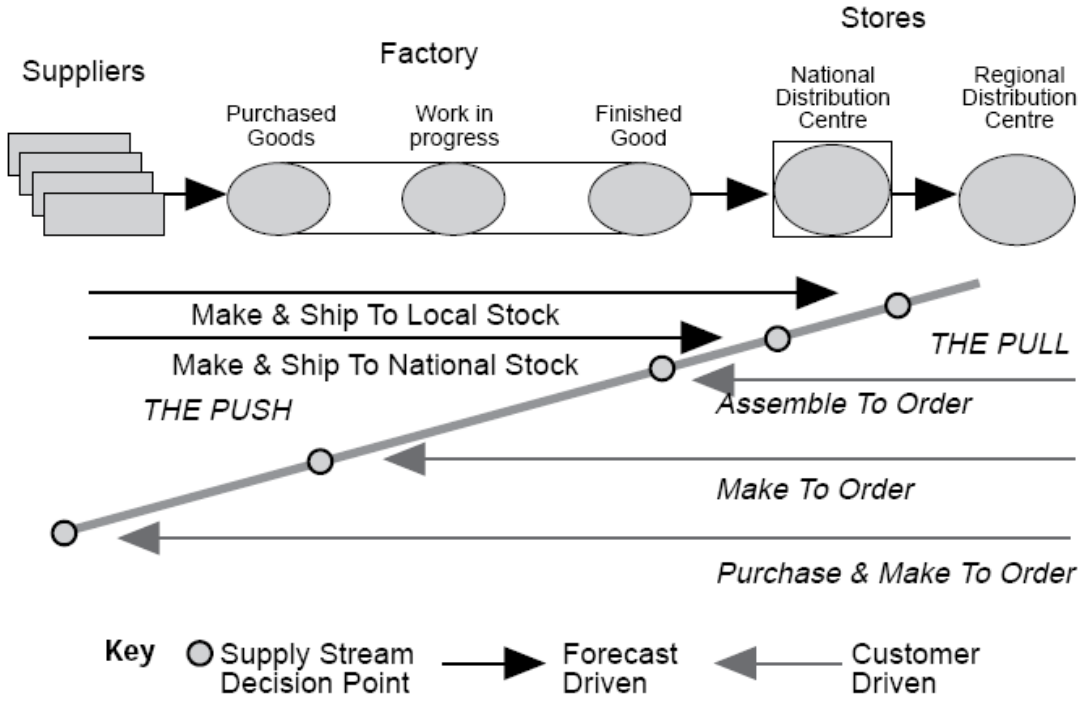
- Gain an insight into detailed batch sizing and scheduling policies, looking at quantity and timing in order to examine the reasons for excessive batches or lack of synchronization.
- Check inventory decisions.

The graph may be plotted both within a company and along a supply chain (Hines et al, 2002).

2.8.6 Decision Point Analysis

Decision point analysis is of particular use for "T" plants or for supply chains that exhibit similar features, although it may be used in other industries (Hines & Rich, 1997). The decision point is the point in the supply chain where actual demand pull gives way to forecast-driven push. Thus, it is the point at which products stop being made according to actual demand and instead are made against forecasts alone (Jones et al, 1997). As it can be seen from Figure 19 in a Fast Moving Consuming Goods industry example the decision to make and ship to local stock and the decision to make and ship to National Stock is in "THE PUSH" side. On the contrary all other decisions are in "THE PULL" side.

Figure No 19. Decision Point Analysis



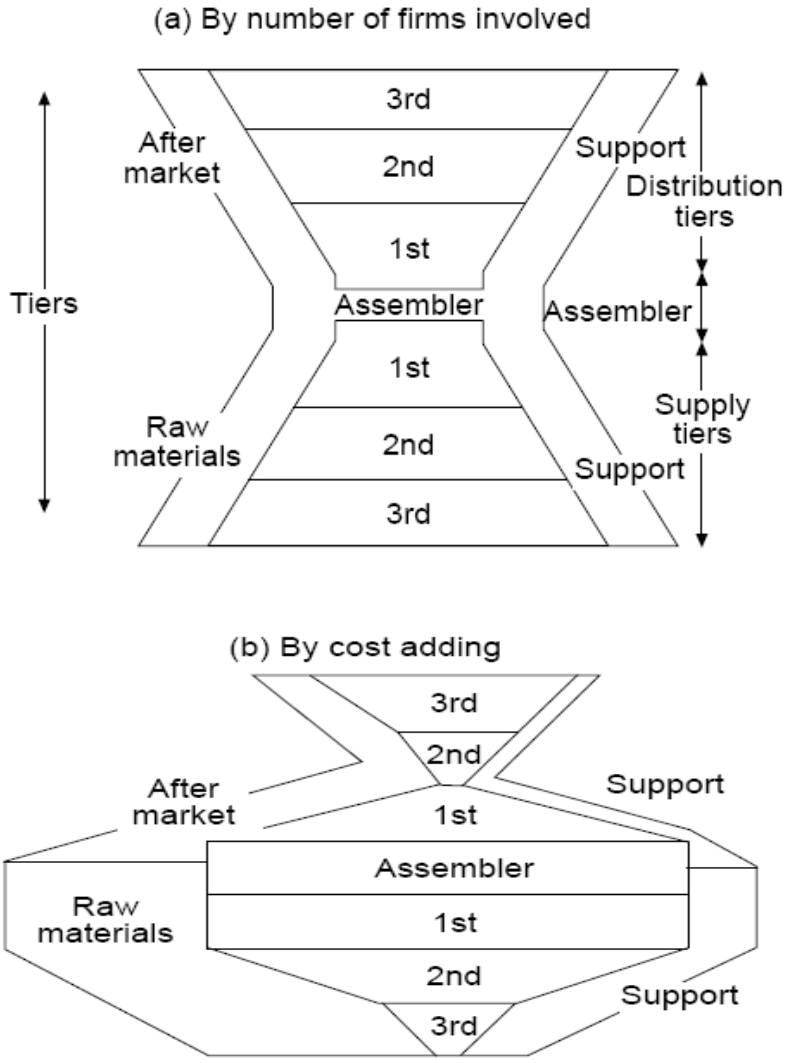
Source: Hines & Rich (1997): The seven value stream mapping tools

This tool can be very useful once understood for two reasons: First, at the immediate level, it becomes possible to assess the processes that operate both downstream and upstream from this point. The purpose of this is to ensure that they are aligned with the relevant pull or push philosophy (Jones et al, 1997). Second, at a more fundamental and longer-term level, it is possible to design various "what if" scenarios to view the operation of the value stream if the decision point is moved. As a result, this may allow for a better design of the value stream (Hines & Rich, 1997).

2.8.7 Physical structure

Physical structure mapping is a new tool which has been found to be helpful in understanding what a particular supply chain looks like at an overview or industry level (Hines & Rich, 1997). As it can be seen in Figure 20 the tool is split into two parts and specifically by (a) volume structure and (b) cost structure.

Figure No 20. Physical Structure Map



Source: Jones et al (1997): Lean Logistics

Figure 20 (a) shows in this example the structure of an automotive industry according to the various tiers that exist in both the supplier area and the distribution area, with the assembler located in the middle point. It can be seen that there are three supplier tiers as well three distribution tiers. Moreover, the supplier area is seen to include raw material sources and other support suppliers such as tooling, capital equipment and office supplies firms. It can be observed that these two sets of firms are not given a tier level because they interact with the assembler and the other supplier tiers as well. In addition, the distribution area of the figure includes three tiers as well as a section representing the after-market, in this case for spare parts, as well as various other support organizations providing consumables and service items. Therefore, this complete industry map captures all the firms involved with the area of each part of the diagram proportional to the number of firms in each set.

The second diagram in Figure 20(b) maps the industry in a similar way with the same sets of organizations. However, instead of linking the area of the figure of the diagram to the number of firms involved it is directly linked to the value-adding process or more strictly speaking to the cost-adding process. As it can be seen in this automotive case, the major cost adding occurs within the raw material firms, the first-tier suppliers and the assembler

themselves. In this case distribution costs are not significant. With the use of this tool similar attempts as in the case of process activity mapping tool can be made in order to eliminate unnecessary activities, simplify orders, and in general seek changes that will reduce waste (Jones et al, 1997).

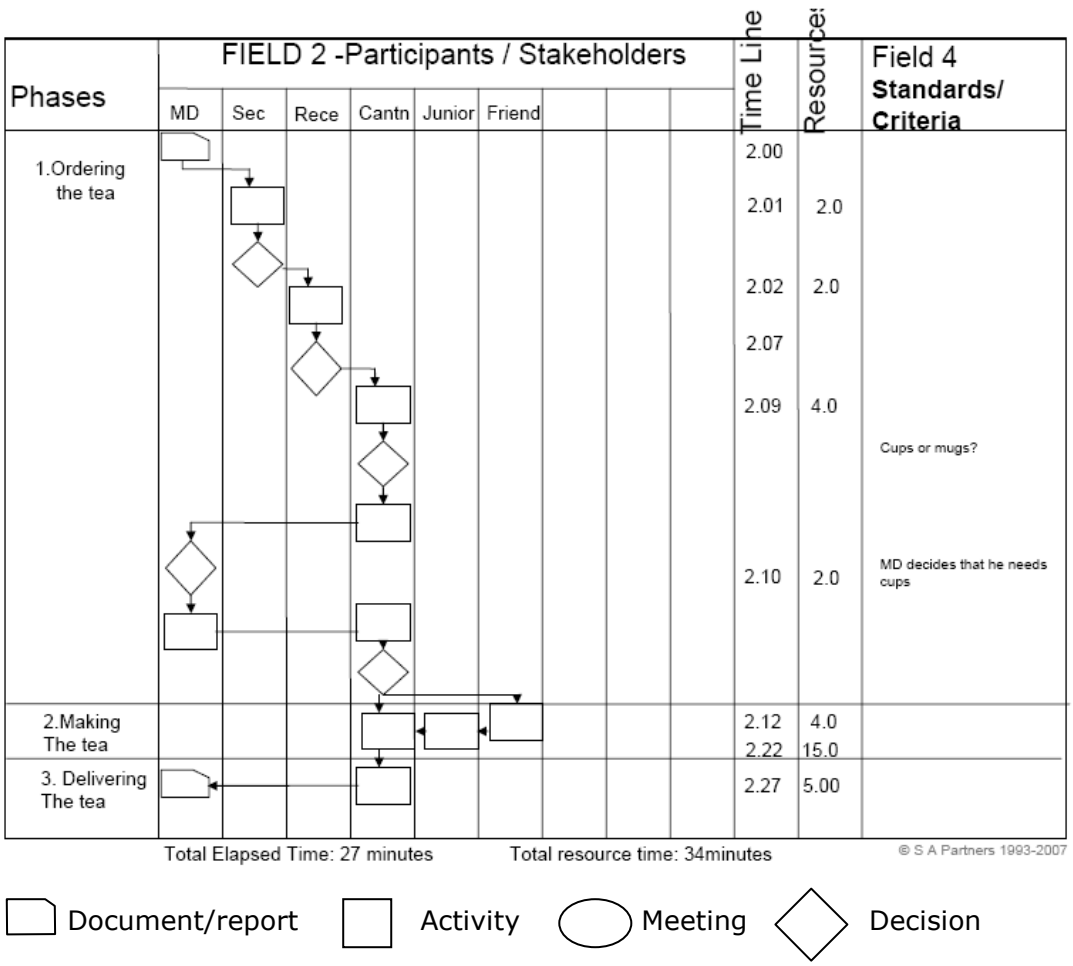
2.8.8 The 4 Fields Mapping

Four fields mapping is an extra tool from the initial 7 tools provided to the author in a personal interview with Professor Peter Hines. This technique is useful for process mapping, especially for information flows and identifies the WHAT, WHO, WHY and HOW of a process (Hines et al, 2008). Its name is based on the four questions mentioned above which are specifically described as follows:

1. WHAT: The first field takes into account the phases that the process goes through.
2. WHO: The second field relates to the stakeholders that are involved.
3. HOW: The third field describes the activities that take place.
4. WHY: The fourth field recognises the criteria, or standards, that have to be met.

In Figure 21 an example of a process for ordering tea is illustrated.

Figure No 21. The 4 fields mapping



Source: Hines (2008): Personal Interview with Professor Hines

As it can be seen in this example, in the first field there are three phases and the participants displayed in the second field are the Managing Director (MD), a secretary (Sec.), the Reception (Rece), the canteen (Cantn), a junior trainee (Junior) and a friend (Friend). The third field describes the activities that take place with the use of the 4 flowchart shapes. Last, in the fourth field the hurdles which must be met in the decision making process are presented.

Standards could also be shown in the fourth field which basically is the minimum acceptable level to which a task must be performed.

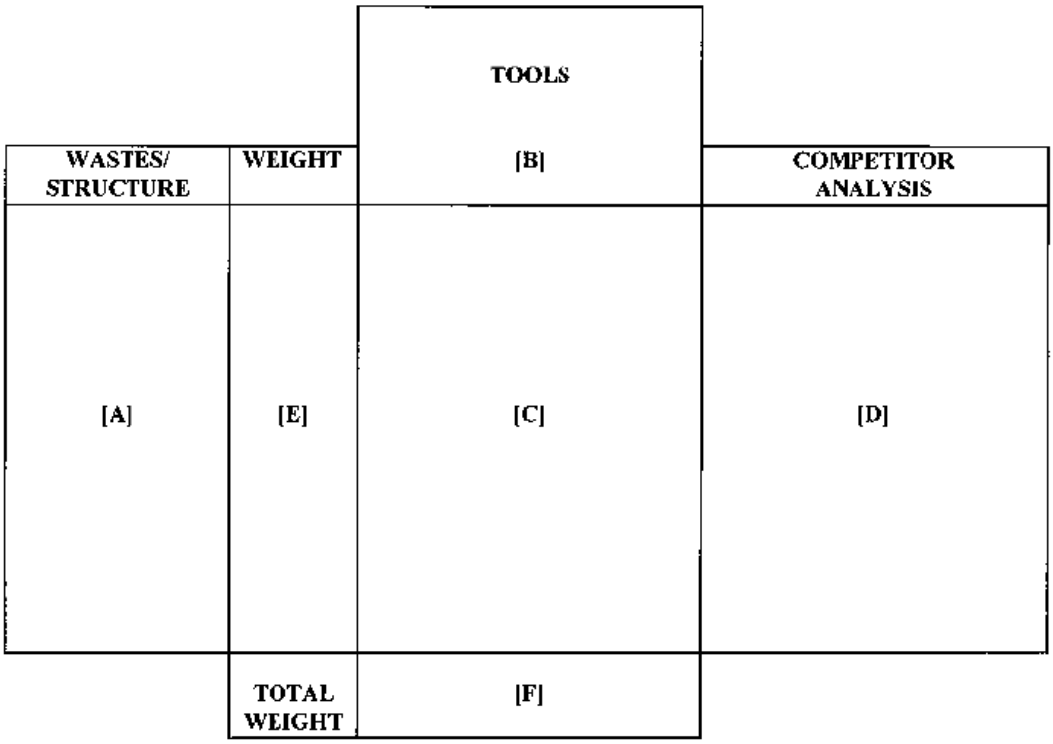
A time line can also be added to show the chronological recording of elapsed time starting from day 0. In addition, this tool provides the resource which is the amount of people hours consumed by the process. With the use of this tool the mapper can identify the 7 initial wastes, participants/stakeholders not involved early enough, sequential communication followed by sequential activity and lack of standards.

2.9 Using the toolkit of Value Stream Mapping

The decision of which tools to use and under what circumstances, can be taken with the use of the value stream analysis tool or otherwise known as VALSAT (Hines & Rich, 1997). This tool can be seen in Figure 22 or in more simplified version in Figure 23. After the value stream for investigation is selected a series of preliminary interviews with managers in the value stream must be conducted in order to identify the various wastes that exist in the value stream (Hines & Rich, 1997). It is necessary for the mapper to provide the interviewees a written overview of the wastes translated in a terminology suitable for the industry under investigation. The collection of these data can also be achieved through participant

observation/contextual inquiry and grounded theory approach (Hines et al, 2000).

Figure No 22. The VALSAT tool.



Source: Hines & Rich (1997): The seven value stream mapping tools

Once this step is done, then the reworded seven wastes and the account of the overall structure are recorded as row eight in the VALSAT table in Figure 23 or as eight rows in area A of Figure 22. The difference between those two figures is that Figure 23 is a simplification of Figure 22 but with sections A, B and C already completed. It is important to note that C is the correlation between tools and wastes. Hines & Rich (1997) propose that at this stage it will be informative to ask the firm or firms involved to identify for

each of the wastes or structure the benchmark company in their sector. Thus, it will be easier to reduce particular wastes and manage their complete supply/distribution chain. In section E, the individual importance weighting of the seven wastes and the overall structure is recorded by allocating a total of 40 points for the eight factors. The last arithmetical stage of this approach is to create total weights of each tool by giving each of the different correlations a score and then for each correlation a total importance score is calculated. Once this is complete the total scores of each column are then summed and recorded in the total weight section named F.

Figure No 23. A simplified form of the VALSAT tool.

	Mapping tool						
Wastes/structure	Process activity mapping	Supply chain response matrix	Production variety funnel	Quality filter mapping	Demand amplification mapping	Decision point analysis	Physical structure (a) volume (b) value
Overproduction	L	M		L	M	M	
Waiting	H	H	L		M	M	
Transport	H						L
Inappropriate processing	H		M	L		L	
Unnecessary inventory	M	H	M		H	M	L
Unnecessary motion	H	L					
Defects	L			H			
Overall structure	L	L	M	L	H	M	H

Notes: H =High correlation and usefulness
M = Medium correlation and usefulness
L = Low correlation and usefulness

Source: Hines & Rich (1997): The seven value stream mapping tools

Hines et al (2000) state the following benefits of the VALSAT approach:

- The technique itself tends to force both cross-functional and cross-organizational working.
- It tends to help to de-select 'hobby horse' projects that minority interests in an organization want to pursue, if such projects are inappropriate.
- It highlights where potential breakthroughs may occur and gives an indication of whether these, perhaps longer-term projects are worth developing.

Hines et al (2000) also state the following weaknesses of the VALSAT approach:

- Initial appears complex and difficult to understand.
- Has to assume a relatively stable environment between iterations.
- Increases time spent on analysis stage of projects.

2.10 Benefits of VSM

According to Manos (2006) VSM is one of the most powerful lean tools for an organization wanting to plan, implement and improve on its lean journey. Other diagnostic tools developed for the removal of wastes in the supply chain have been proven to be weak

on a wider applicability when used on their own and as a result the Value Stream Mapping approach was developed (Hines et al, 1998). According to Rother & Shook (1999) Value Stream Mapping has the following benefits:

- It helps its users visualize more than just the single-process level, i.e. assembly, welding, etc., in production, thus you can see the flow.
- It helps its users see more than just waste as the mapping helps users to see the sources of waste in their value stream.
- It provides a common language for talking about manufacturing processes.
- It makes decisions about the flow apparent, so they can be discussed.
- It ties together lean concepts and technique, which helps implementers avoid "cherry picking".
- It forms the basis of an implementation plant since the design of the door-to-door flow becomes a blueprint for lean implementation.
- It shows the linkage between the information flow and the material flow, a benefit that no other tool offers.
- It is much more useful than quantitative tools and layout diagrams that produce a tally of non-value-added steps, lead time, distance traveled the amount of inventory and so on.

2.11 Limitations of VSM

As of January 1998, the Value Stream Mapping has been applied in over 30 different value streams from a wide range of environments spanning the automotive component industry, capital equipment manufacture, electrical distribution, food retailing, telecommunications and public sector administration (Hines et al, 1998). The VSM has been used most intensively and detailed within the Lean Processing (LEAP) Program which was a three year government and industry funded research program in the U. K. upstream automotive industry. Hines et al (1998), states that during this projects the following limitations have been identified which were categorized into those specifically connected with the method, those regarding the general environment of use and those involving wider limitations of its use:

1. Specifically connected with the method: Wastes that were found within a supply chain setting such as wasted energy and the waste of human potential when human resources are under used or their value and contribution were not recognized. Furthermore, it soon became apparent that the seven initial tools did not cover every eventuality and were weaker in some circumstances, such as in mapping information flows. The difficulty when mapping information flow lies in its invisible nature and because it does not follow a

linear path in contrast with material flow. The information flow backtracks, jumps around various operations and at times intermingles with the physical movement of material (Mehta & Rampura, 2006). Also, the method's concentration on those linked activities that went towards producing a single or closely related group of products or services presented a weakness where value streams met. In addition, it was often difficult for the company or companies involved to understand how the mapping method was translated into a particular "Chocolate box" and the selection of one method over the other.

2. Related with the general environment in which VSM was used: First, the companies studied did not have the knowledge of Value Stream Mapping and therefore it was difficult for them to grasp some of the concepts being put forward. Second, another general weakness of the method was that at least 50% of the useful information that was collected during the mapping process was subjective, informal or even by way of participant observation. The last general limitation is that it is very time consuming to undertake.

3. Wider limitations: First, there was a lack of understanding in the management and specifically of their position within the

supply chain and the results of their actions on other members of the supply chain. Suck lack of knowledge in the supply chain made the correction of problems difficult. Second, the Value Stream Mapping method was not explicitly linked to the corporate strategy and the wider business environment and as a result the mapping was done in isolation of the needs of the company. In addition to this, Value Stream Mapping has far too often focused on the order fulfilment or supplier integration processes ignoring other key processes such as product development and human resource management.

III. RESEARCH METHODOLOGY

The methodology designed for this project was decided and implemented having in mind the problem, objectives, assumptions, challenges already mentioned in sections 1.1, 1.2, 1.3, and 1.4 respectively. First, it was necessary for the author to research the literature regarding the Lean philosophy and specifically the Value Stream Mapping technique in order to learn how to implement it. Available case studies with companies who applied this technique were also gathered. Then, the author thought it was important to seek guidance from someone who had applied this technique in companies and specifically in environments other than manufacturing. Therefore, it was decided to meet Professor Peter Hines in Cardiff, Director of the Lean Enterprise Research Centre (LERC) and Director of the Cardiff University Innovative Manufacturing Research Centre (CUIMRC).

In accordance with the literature related to this technique, the product family and the specific value stream for investigation was chosen later on, after an agreement with Voici La Mode Group of Companies. In a later stage, it was necessary for the author to understand the flow of products and flow of information before mapping the current state. Therefore, it was decided to start on site observations from the M & S stores and then moving upstream to

the main Distribution Centre in Cyprus and then in Hemel-Consolidation Centre in Hemel Hempstead in the UK. Interviews were conducted in all locations with managers, decision makers and some first line employees. In total, 27 interviews were conducted and in every interview, the Lean Philosophy, the Value Stream Mapping technique and the different wastes were explained shortly to the interviewees. The purpose of these interviews was to understand the current state and collect primary and secondary, qualitative and quantitative data.

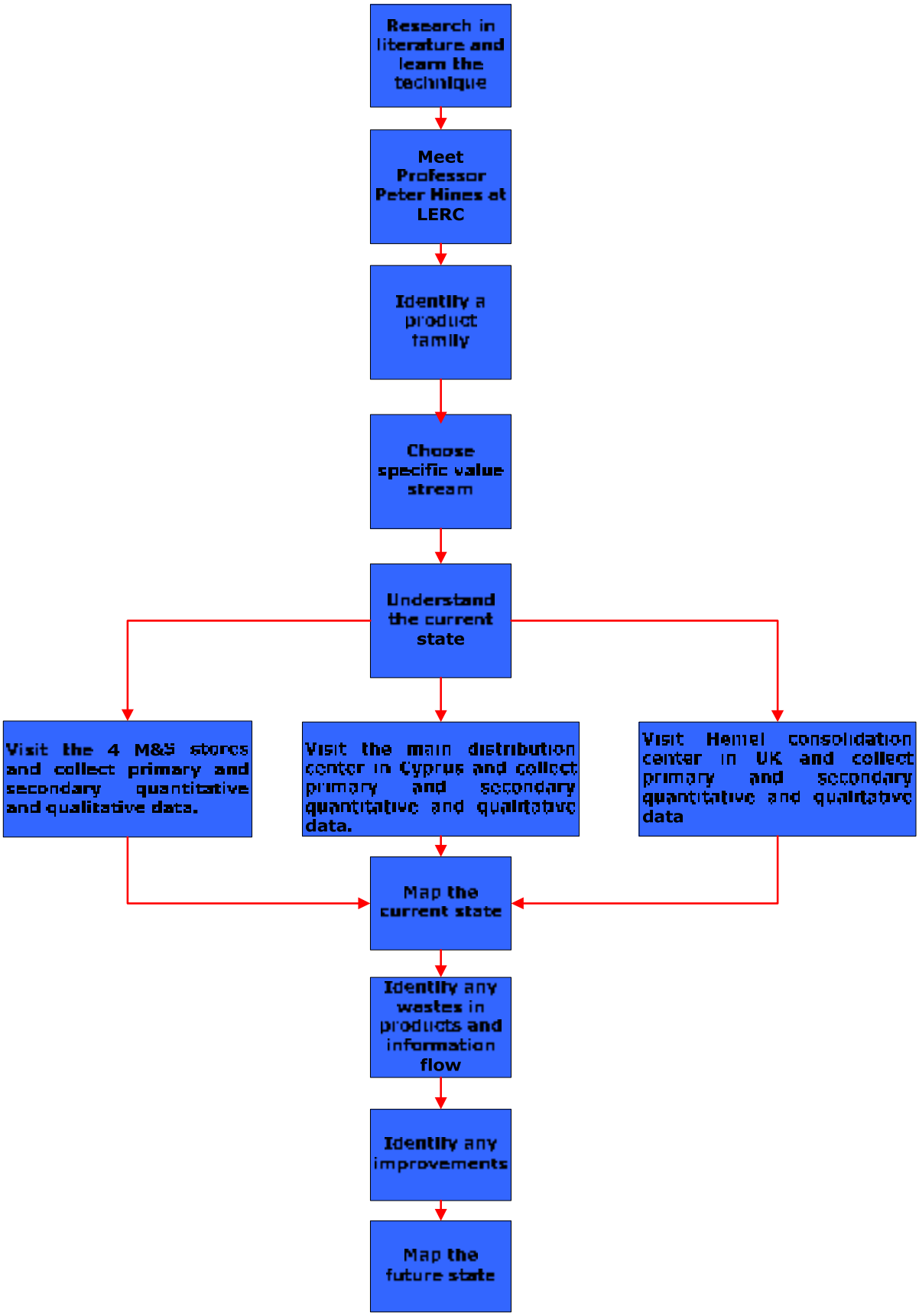
Specifically, in Hemel, the flow of products and the flow of information were recorded with the assistance of one of the Operations Managers and the Manager in the help desk department. Parallel, a constant communication with the International Logistics Manager of M & S was being kept and any information, where it was available, related to the supply chain of the International Accounts was being provided.

In Cyprus, the operations of the main Distribution Centre and the M & S stores were observed and primary and secondary data were collected as well. A questionnaire was also given to all 21 decision makers within the Company in order to analyze some issues raised during the interviews (Appendix 1). After the collection of all data the current state was mapped with the use of a number of mapping

tools selected from the set of tools analyzed in the literature review in Chapter 2. In addition, some guidelines from Professor Peter Hines were also implemented to map the current state.

With this mapping and generally all the data gathered any wastes in the flow of products and flow of information were identified in order to be analyzed for possible improvements. Last, the future map without the wastes identified and with suggestions for improvements within the Group was constructed. The steps of the methodology taken are illustrated in Figure 24.

Figure No. 24. The steps of the project's methodology



IV. COMPANY DESCRIPTION

Voici La Mode Group of Companies started operation in Cyprus in 1959 and specifically in Nicosia's district, which is the capital, with the company Voici La Mode Ltd as a franchisee partner of Marks & Spencer UK. Voici La Mode Ltd is one of the many International Accounts of Marks & Spencer UK and is also known as Cyprus 2 Account.

In 1995, the Acropolis Building started operations with a total retail area of 3,500 square meters. The Acropolis Building is the main branch and the Group's headquarters are being held there. The other three stores are the Makariou, Latsia, and Lakatamia.

In 1997, a new company with Cafés was created by the name Café La Mode Ltd opening the first Café in Acropolis Building and later on followed by the Café at Makarios Avenue.

In 2005, the business opened the Marks and Spencer Home store in Limassol Avenue in Nicosia. The store is the first of its kind internationally. In the same year, a third Café was opened next to the Home Store.

In 2006, Francium Enterprises were added to the Group with two stores in Nicosia as a franchisee of CELIO, French menswear clothing. Recently, in 18th of August 2008 a new M & S store was

added to the company operating as an outlet store. Therefore, the company is currently operating six M & S stores and the total work force of the Group is over 250 employees. The organization chart of the company can be seen in Appendix 2.

The Company's stores are being serviced by two Distribution Centers which are located at Dali Industrial Area, 8 km away from Nicosia. Voici La Mode Ltd sells a variety of products which reaches up to 97 categories of products known as Departments (Appendix 3). Each store sells different products and for this reason the products are distributed accordingly to the stores from the two Distribution Centers (Appendix 4). The 4 M & S stores and the main Distribution Center under investigation can be seen in a map which shows their location with the distances between them (Appendix 5).

It is important to note that Voici La Mode Ltd is not the only franchisee of M&S UK in Cyprus since there is one more. For that reason, the two franchisees, which are independent, are separated into two Accounts which cover different areas. Voici La Mode Group of Companies is the Cyprus 2 Account, which has operations in the capital's district, Nicosia, while the other franchisee is the Cyprus 1 Account which operates in the coastal cities of the island (Appendix 6). Despite of the independence of the two Accounts in terms of geographical coverage and legal definition, the decision of setting

the prices of the products are jointly agreed so that same products will not have great difference in prices.

V. CURRENT STATE MAP

5.1 Setting the direction for applying lean thinking

The following analysis presented in this section is a result of the data gathered from the interviews and the questionnaire conducted within the Company and the personal observations of the author as mentioned in detail in Chapter 3. The purpose of this analysis is to provide an insight of the strengths, weaknesses, opportunities and threats of the company as well as the core activities of the company. In addition, the value from the customer's perspective was identified as suggested in the literature in Chapter 2. Thus, the core activities to be mapped in detailed were stated and a set of mapping tools were selected for use. As advised by Hines & Taylor (2000) once these steps are achieved it is easier to set the direction for applying lean thinking. The sections 5.1.1, 5.1.2, 5.1.3 and 5.1.4 were partly based on the guidelines suggested by Professor Peter Hines.

5.1.1 SWOT Analysis

The M & S stores in Cyprus are well known in the Cypriot market and the M & S products are also well known for their good quality and price. The stores cover a wide geographical area of the capital's district as it can be seen in Appendix 4. In addition, the M & S stores in Cyprus are also well known for the good customer service in terms of availability of products, acceptance of returned products from customers and the level of service offered by the salespeople. Also, M & S Cyprus 2 Account has a larger variety in comparison with the direct competitor which is M & S Cyprus 1 Account. Furthermore, the sales of fashion products have been increased by 10% from 2006 to 2007 and the operation of another M & S store as outlet is very promising for a further increase in sales. The company will expand more in the near future with more stores. Great investment has been made in Logistics facilities with a recent expansion of the main DC and the construction facilities to preserve frozen foods. Also experienced new staff has been recruited the last two years in managerial positions.

However, the company faces a great increase in employees' turnover from 5% to 13% between 2006 and 2007. This phenomenon appears to be intensive from first line employees in the 2 Distribution Centers and the M & S stores causing discontinuous operations and consumption of time for training.

Moreover, it was observed that the technology used in operations in the Distribution Centers is degraded and inappropriate procedures were identified.

The following findings were provided by statements in the interviews from decision makers and were supported with the questionnaire results shown in Table 1. The database system used by decision makers, known as MMH, is degraded as the data are not presented in a simple form suitable for analysis. This was supported by the findings of statement 10. Furthermore, the statements of No. 1, 2 and 4 support that there is a problem in communication and coordination between the different departments and that the lack of necessary information is an obstacle for employees performing their duties. It was proven that the majority of the decision makers use the phone and personal contact more than any other means of communication.

Specifically, the usage of e-mails and faxes which are written means of communication were second and third respectively in preference while surprisingly there was usage of SMS messages as well (Table 2). The fact that the written forms of communication are not so preferable by decision makers raises concerns regarding the efficiency of communication and the lack of standardization in the way communication is performed. Moreover, whatever it is not

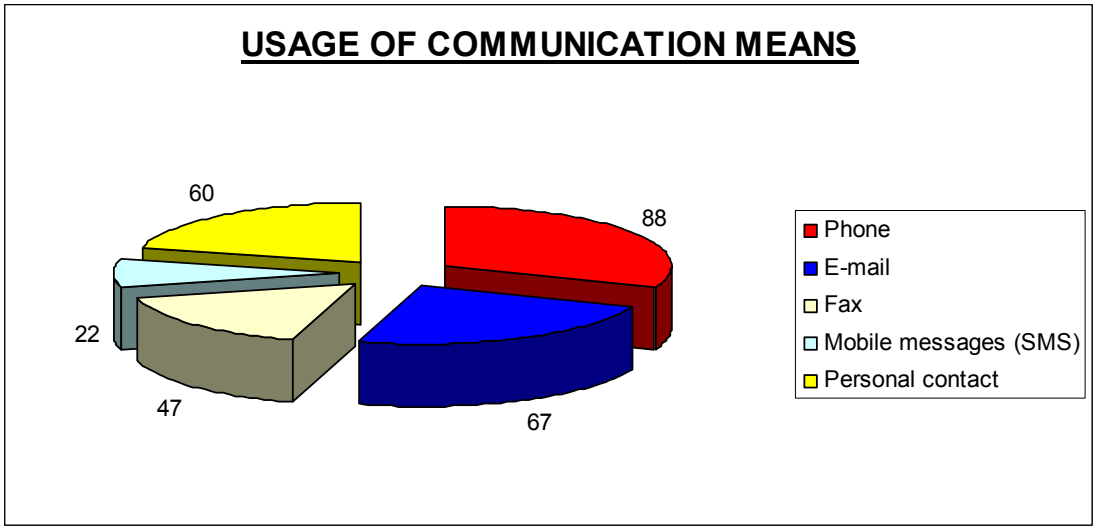
written cannot be recalled at any time in the future. A further support of the lack of good communication between departments is the statement that the number of staff meetings is not enough. This was proved by the results of statement 7 as shown in Table 1. Last, a lack of correct planning was stated with a result of often last minute changes. This was supported by the results of statement 5.

Table No.1 Questionnaire results.

No.	QUESTIONNAIRE STATEMENTS	AVERAGE
1	The communication between the different departments is good.	**2,651678**
2	There is good coordination between the different departments.	**2,631579**
3	There is continuous enforcement of the hierarchy in case of report of any problem.	**3,166667**
4	I **do not** have all the necessary information to conduct my duties.	**3,254678**
5	There are often last minute changes.	**4,526316**
6	There are predetermined procedures for the report of problems.	**3**
7	The existing staff meetings are enough.	**2,842105**
8	There are written procedures that I follow in order to perform my duties.	**3,052632**
9	The time of the staff meetings is enough.	**3,421053**
10	I am satisfied with the existing software of database (MMH).	**2,642857**
11	The existing staff meetings are productive.	**3,277778**
12	I have been trained satisfactory to perform my duties.	**4,055556**

*** Statements with averages 3 and above are correct.**

Table No.2 Questionnaire results.



Through the interviews it was also stated that the dependence on Cyprus 1 Account for setting the prices of products is causing delay in the operations of the main Distribution Center and sudden notifications once prices are agreed. Moreover, the company faces threats form the entrance of well known multinational companies such as Carrefour which sells a variety of products including apparel. Also, the recent trend of forming big Shopping Malls in Nicosia which include not only apparel stores but many different amusement activities, attract a great number of consumers. Considering the fact that the M & S stores are not situated in these Malls raises great concerns. The points of this SWOT analysis are summarized in Table 3. The strengths and weaknesses derive within the company while the opportunities and threats from the external environment of the company.

Table No. 3. SWOT analysis

Strengths	**Weaknesses**
• M & S's products have good brand image. • The M & S stores cover a wide geographical range of the capital's district. • The M & S Cyprus 2 Account has a greater range of products than Cyprus 1. • From 2006 to 2007 the increase in sales of fashion products was 10% average. • Dynamic growth. • New, experienced staff recruitments. • Investments in Logistics Facilities and new stores.	• From 2006 to 2008 there is an increase in first-line employees' turnover from 5% to 13%. • Degraded technology used in operations in Distribution Centers. • Degraded software of database. • Not very good coordination between departments. • Not very good communication within the group. • Lack of necessary information. • Lack of good planning. • Interdependence on Cyprus 1 Account on the setting of prices of products and marketing decisions.
Opportunities	**Threats**
• Increase in demand for the company's products.	• Entrance of multinational companies in the industry. • The trend of opening stores in big Shopping Malls with a number of different amusement activities.

5.1.2 Value Identification

In accordance with the theoretical framework in Chapter 2, the identification of value from the customer's perspective was identified. Kotler & Armstrong (2004), state that the consumers' behavior can be influenced by cultural, social, personal and psychological factors. Taking into consideration that these factors are different from customer to customer and therefore their views might be subjective, it was decided not to ask a sample of them in order to avoid wrong identification of value.

Thus, by conducting interviews with the Operations Manager, the Marketing Manager, the Store Managers and the Store Consultant it was unanimously agreed that the Company's target market was considering value more in terms of great service. This service includes the availability of products, acceptance of returned products from customers and the level of service offered by the salespeople.

5.1.3 Identification of core activities

Considering the statements of all interviewees and specifically the SWOT analysis in section 5.1.2, Table 4 was prepared. The table shows horizontally a set of business processes highlighted with blue and vertically a set of targets which were a result of the statements

of decision makers. It can be seen that with a response of YES, MAYBE or NO the question of whether these business processes are likely or not to yield benefit to each of the targets was answered. A definition of the business processes is summarized in Table 5.

Table No. 5 Definitions of key business processes

Key business process	Definition
Continuous Improvement	Continuous radical or incremental improvement of all other processes.
Product lifecycle management	Managing customer needs for new products, introducing them into the market and retiring old products.
Order Acquisition	All activities performed to create an order.
Order fulfillment	All activities from Hemel to Cyprus DC and from Cyprus DC to stores.
Human Resource development	Developing, managing and maintaining employees.
Strategy & policy deployment	The strategic management of the company, focusing of change and managing critical success factors.
Technology, plant and equipment management	Developing, managing and maintaining operating equipment (including IT).
Sales acquisition	Winning new business with new or existing clients.

Table No. 4. Identification of gains on target areas with business processes

	Continuous Improvement	Product lifecycle management	Order Acquisition	Order Fulfillment	Human Resource development	Strategy & policy deployment	Technology, plant and equipment management	Sales acquisition
Return on capital	Yes	Maybe	Maybe	Maybe	Maybe	Maybe	Yes	Yes
Net cash	Yes	Maybe	Yes	Yes	Maybe	Maybe	Maybe	No
Stock turn	Yes	Maybe	Yes	Yes	Maybe	Maybe	Maybe	Maybe
Overall equipment effectiveness	Yes	No	Yes	Yes	Maybe	Maybe	Yes	No
Total cost reduction	Yes	Yes	Yes	Yes	Maybe	Maybe	Yes	Maybe
Employees turnover	Yes	Yes	Yes	Yes	Yes	Yes	Maybe	Yes
Market share	Yes	Yes	Maybe	Maybe	Maybe	Maybe	Maybe	Yes
Sales to new customers	Yes	Maybe	Maybe	Maybe	Maybe	Maybe	Maybe	Yes
Product quality	Yes	Yes	No	No	Maybe	Maybe	Yes	No
New product sales	Yes	Yes	Maybe	Maybe	Maybe	Maybe	Maybe	Yes
TOTAL	**10 Yes 0 Maybe 0 No**	**5 Yes 4 Maybe 1 No**	**5 Yes 4 Maybe 1 No**	**5 Yes 4 Maybe 1 No**	**1 Yes 9 Maybe 0 No**	**1 Yes 10 Maybe 0 No**	**4 Yes 6 Maybe 0 No**	**5 Yes 2 Maybe 3 No**

On a later stage, having in mind the identification of which processes are likely to yield the greatest gains against the target areas, the processes were classified into the following three categories: a) Strategic, b) Core and c) Support processes. The categorization is presented in Table 6.

Table No. 6. Identification of core processes

Strategic processes	Core processes	Support processes
Strategy and policy deployment	Order acquisition	Human resource development
	Order fulfillment	Continuous Improvement
	Technology, plant and equipment management	
	Sales Acquisition	
	Product lifecycle management	

From the set of the core processes identified it was decided that the Order Acquisition process and the Order Fulfillment process will be mapped in detail. This decision was based on the fact that the majority of the problems stated through the interviews were in those two processes. Considering also the time needed to map a process in detail and the time available for this project it was decided to focus on those two processes.

5.1.4 Selection of Value Stream Mapping tools

The interviewees were first given a description of the 8 mapping tools and the different wastes which are explained in detail in section 2.9. Then they were asked which tools would be helpful to be used based on the objectives of the tools, the wastes they could identify in the activities that they were involved in and the data available to use or extract. The feedback was recorded in the form of a YES, MAYBE or NO response which is illustrated in Table 7.

Table No. 7. Selection of the appropriate mapping tools

	Process Activity Mapping	Supply Chain Response Matrix	Production Variety Funnel	Quality Filter Mapping	Demand Amplification Mapping	Decision Point Analysis	Physical structure	4 Fields Mapping
Overproduction	Maybe	Maybe	No	Maybe	Yes	Yes	No	Maybe
Waiting	Yes	Yes	No	No	Maybe	Yes	No	Yes
Excessive transportation	Yes	No	No	No	No	Maybe	No	Yes
Inappropriate processing	Yes	No	No	Maybe	No	No	No	Yes
Unnecessary Inventory	Maybe	Yes	No	Maybe	Yes	Yes	No	Maybe
Unnecessary motions	Yes	Maybe	No	No	No	Maybe	No	Yes
Defects	Maybe	No	No	Yes	No	No	No	No
TOTAL	**3Maybe 4 Yes 0 No**	**2 Maybe 2 Yes 3 No**	**0 Maybe 0 Yes 7 No**	**3Maybe 1 Yes 3 No**	**1 Maybe 2 Yes 4 No**	**2 Maybe 3 Yes 2 No**	**0 Maybe 0 Yes 7 No**	**2 Maybe 4 Yes 1 No**

As can be seen from the results of Table 7 the tools with the less appropriate use are the Production Variety Funnel and the Physical structure which gathered the most "NOs". The Production Variety Funnel was found unnecessary as the value stream examined does not include any production facilities. The Physical structure was considered impossible to be implemented and the data related to cost which were needed for such analysis are beyond the scope of this project. Although a structure of the supply chain could be done using this tool, such analysis could also be achieved with the use of the other tools. In addition, the Quality Filter Tool was not selected as very suitable because from the three types of defects explained in detail in section 2.8.4 only the service defects were suitable to be measured but it was observed that these were minimal. So, it would have been meaningless to count something that it was not happening. As a result the mapping tools selected for this project were:

- The Process Activity Mapping.
- The Supply Chain Response Matrix.
- The Demand Amplification Mapping.
- The Decision Point Analysis.
- The 4 Fields Mapping.

5.2 Mapping the core activities

In this section the mapping of the core processes, Order acquisition and Order Fulfillment is presented. This is an investigation in more depth to examine the feedback from the interviews and the personal observations. The implementation of the mapping tools selected in the value stream under investigation is also presented, accompanied with all necessary descriptions. The order of presentation is based on the convenience of the reader. Specifically, the Order Acquisition process is mapped first with the use of the 4 Fields Mapping in order to provide insight on how an order is created.

Then, the Order Fulfillment process is mapped with the use of the Decision Point analysis first, in order to show the general structure of the supply chain, how the products flow from UK to Cyprus and where the products are pulled or pushed. Then, the results from Demand Amplification Mapping and the Supply Chain Response Matrix are presented to provide a better insight. Last, the Process Activity Mapping conducted in Hemel, the main Distribution Center and two of the stores is presented. In all maps the wastes in information and products flow are identified.

5.2.1 The Order Acquisition Process

The Order Acquisition process involves 7 persons which are the Commercial Manager, the two Merchandisers and the 4 Buyers. This process includes 4 phases which are: 1) catalogues preparation, 2) a meeting, 3) a buying event and 4) an analysis of data and order placement. It is important to be stated at this point that the operations cycle of the company is separated into four quarters which are basically the four seasons (autumn, winter, spring and summer) and therefore this Order Acquisition process occurs 4 times per year.

In the phase 1, the two Merchandisers must prepare catalogues for the season that the Buyers and the Commercial Manager are going to place orders for. This preparation involves gathering of what was sold, what products were as top 10 selling products and other data useful for the decision of what to order. However, this data gathering is done manually which results in the preparation of four excel files within a period of two weeks. With the term "manually" it is meant that the database system (MMH) is not built to extract such results with a push of a button. On the contrary, the Merchandisers must find the data one by one and process them. Later on, these catalogues are processed further by the Merchandisers and within one day, pivot tables are prepared so that

the data will be more meaningful for the Buyers and the Commercial Manager.

In the second phase, the tables prepared by the two Merchandisers are presented to the four Buyers and the Commercial Manager at a meeting held at the headquarters. Each Buyer is responsible for specific products which are separated into 4 categories which are: 1) Men's, 2) Ladies, 3) Children and 4) Lingerie. Likewise, based on these categories the products have been allocated to the two Merchandisers accordingly. As a result, the meeting is split into 4 parts of 1 hour each for the 4 Buyers. The 1st Merchandiser is present for the first two parts, the second Merchandiser for the second part and the Commercial Manager is present at all times.

In the third phase, the 4 Buyers and the Commercial Manager must attend to the Buying event where they look at samples of the products and their prices. The presentation of these products is again organized according to the 4 categories mentioned above and therefore the Buyers attend to the event according to the presentation. Each Buyer spends 2 days there while the Commercial Manager is present the whole period of the event which is 6 days.

In the 4th and last phase, the Buyers are given a week's deadline to conclude with the decision of what and how much products should

be ordered. Then, their decisions are passed on to the Commercial Manager where the final approval for the orders is taken and the orders are placed electronically.

This process is mapped in Table 8 with the use of the 4 Fields Mapping. As it can be seen, in the column "Day" the whole process lasts a total of 26.5 days with a total of 57.6 person's days used as shown in column "Person's days". By recording the resources needed in each phase it can be seen that in phase 1 (a) the preparation of the catalogues requires 20 person's days for just 2 persons due to the degraded technology used. This implies a great amount of time and cost wasted as the employees are working inefficiently to pass on critical information which could be provided faster. Moreover, the Buying event occupies more than half of the

Table No. 8.The Four Fields Mapping

PHASES	PARTICIPANTS/STAKEHOLDERS			TIME LINE		RESOURCES		CRITERIA/ STANDARDS
	Merchandisers	Buyers	Commercial Manager	Calculations	Day	Persons	Person's days	
					0/0			
1. CATALOQUES PREPARATION BY MERCHANDISERS								
a) Write manually what was sold one by one (4 excel files)				2 weeks X 2 persons	10	2	20	Technologically incapable.
b) Tables preparation for meaningful results (pivot tables)	PIVOT			1 day X 2 persons	15	2	2	
2. MEETING		Meeting		Op.M. (4 hrs) + [4xB (1 hrs)=4hrs] +M1 (2 hrs) +M2 (2hrs)/ 7.5 hours	15.5	7	1,6	All parties must conclude on a first estimation of what to order.
3. BUYING EVENT				6 days (2 days x 4buyers) + (6 days x Op.M.)	21.5	5	14	Travel to UK and make a second estimation of what to order.
4. ANALYSIS OF DATA AND ORDER PLACEMENT		N WHAT TO ORDER? Y ORDERS OK? N Y ORDER PLACED		5 days(5d x 4buyers =20)	26.5	4	20	*What products to order? *How much quantity to order? *Have results in one week.
TOTAL				TOTAL TIME TO PLACE ORDERS	26.5	TOTAL RESOURCES	57.6	

Document/report Activity Meeting Decision

***1 Person's week= 5 days**
***1 Person's day= 7.5 hours**

persons involved in this process for a whole week and absorbs 14 person's days. The calculations are based on the fact that 1 person's week is 5 days and 1 Person's day is 7.5 hours. For example, the resources needed for the meeting are 1.6 person's days which are a result of the 12 hours required total from all people participating divided by the 7.5 hours (1 Person's day).

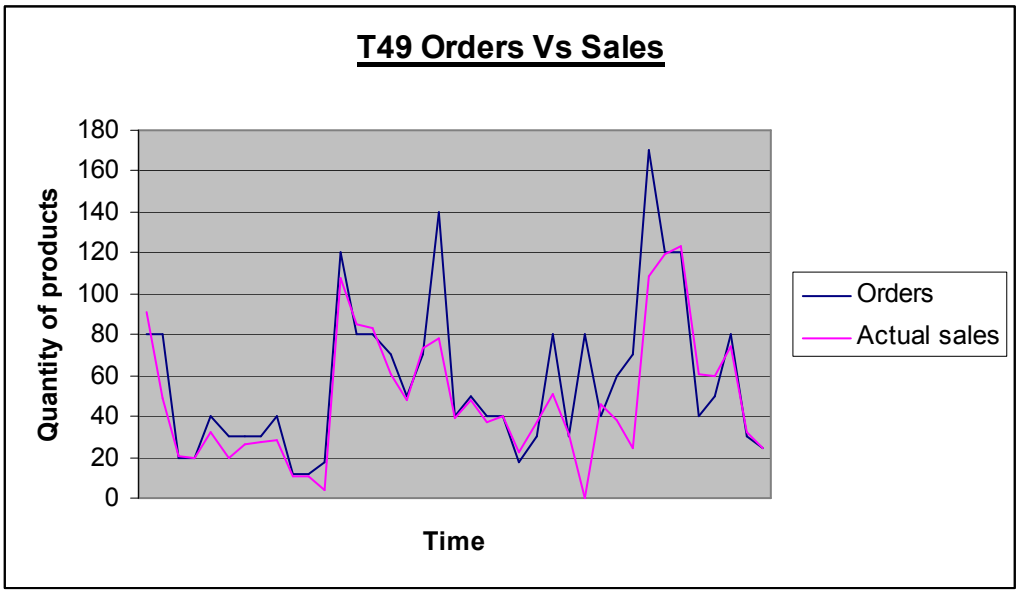
5.2.1.1 Issues related to the orders

The company must place two order quantities: (a) the launch quantity which is the first quantity of season to start with and (b) the season estimate which is the quantity for the whole season. The company can increase the requested quantity during the season. Unfortunately, for some departments the company is forced to acquire the season estimate as launch quantity. Thus, some products arrive in the main Distribution Center and wait for some period until the actual season to be sold commences.

For example, T49, which is the department of ladies' coats and jackets, arrives in August and waits for three months in main DC until October. Therefore, these products are decreasing the available space in the main Distribution Center and are increasing the holding costs. Moreover, this system of "take it in advance or leave it" makes the quantity of orders placed to vary from actual

demand as the orders are placed sooner. In Table 9 this variation of the quantity of orders for T49 and its actual sales in 2007 is presented.

Table No. 9. Demand amplification map-T49.

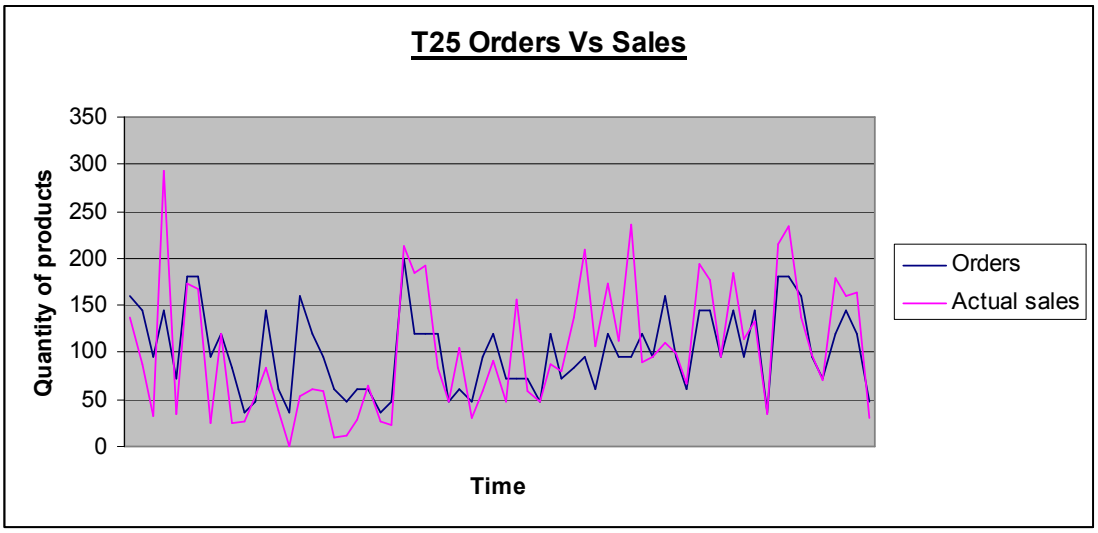


Furthermore, for some other products the order quantities must be placed one year in advance which makes the forecast of sales very difficult. If the fashion trends of such products is changing continuously then this forecast is even more difficult. As a result, there is again variation between orders and actual sales and the Buyers have to increase the quantity during season.

In Table 10, this variation between orders and actual sales in 2007 for T25, which is the department for men's casual shirts, is

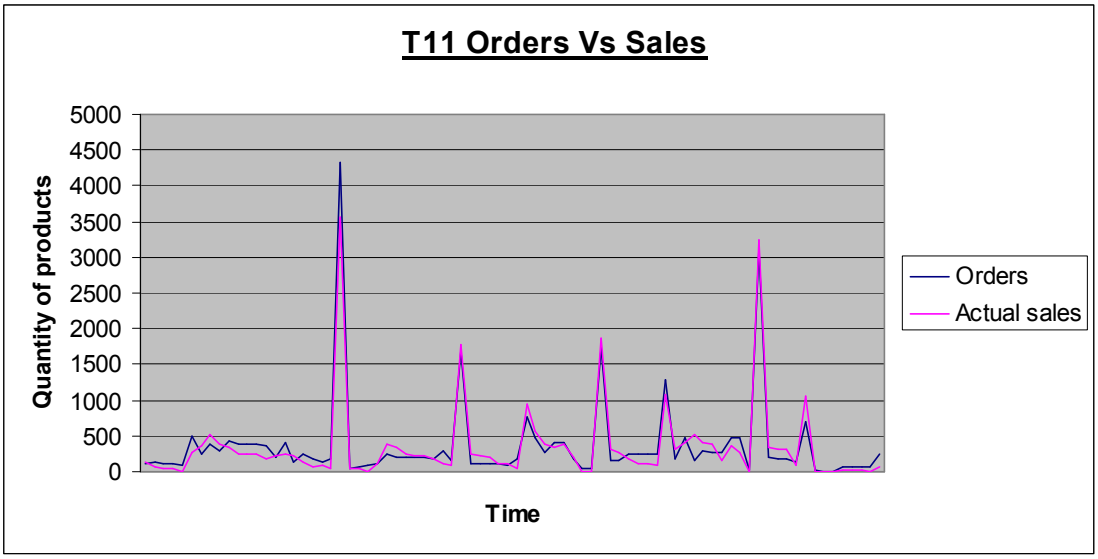
illustrated. Where the sales are more than orders this means that an increase in orders was made during the season.

Table No. 10. Demand amplification map-T25.



On the contrary, products which do not have these peculiarities are more controllable and therefore the quantities of orders have less variation to the quantities of sales. This can be seen in Table 11 where a "good model" of T11's sales and orders are illustrated.

Table No. 11. Demand amplification map-T11.

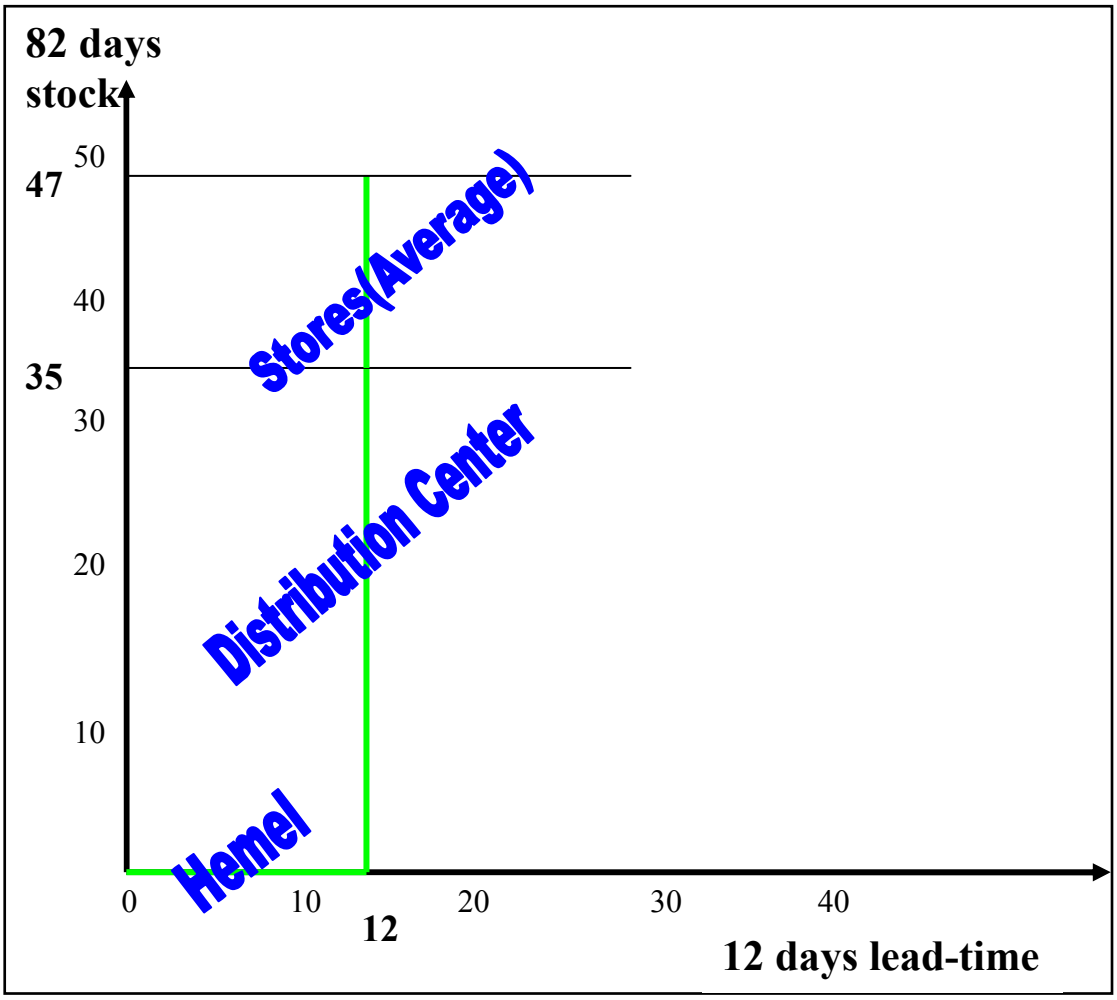


From the analysis above it is concluded that not only an amount of sales is lost but also that the main Distribution Center is processing and holding unnecessary stock related to some departments. Although the company has no control over the decisions related to the orders, still the impact caused by these reasons can be dealt.

The company is not able to know instantly, using the current database system, what was its stock holding over a period of time. However, stock reports are generated twice a week showing the stock holding in main DC and stores. Therefore, a sample of departments was taken and with an analysis of these existing reports the stock held in days within a week was calculated for all the stores in average and the main DC.

The departments selected were the T43, T38 and T64 which are fast moving products. In addition the stock held in Hemel and the lead times between Hemel, main DC and the stores were found. These data are illustrated in the supply chain response matrix in Table 12.

Table No. 12. Supply Chain Response Matrix.



As it can be seen from Table 12, Hemel keeps zero stock while the main Distribution Center holds 35 days of stock and all 4 stores hold 47 days of stock. In total, there is 94 days worth of stock and movement time which may yield a customer service level of 100%.

This analysis shows that nothing is held in Hemel since products are being pushed when the pallets fill a container. However, the operations in Hemel will be analyzed later in section 5.2.2.2. The Distribution Center seems to hold a great amount of stock considering that this amount does not differ greatly with the amount held by 4 stores and that the departments consist of fast moving products. Moreover, it can be seen that the greatest lead time appears to be from Hemel to the main Distribution Center as 12 days are needed for products to arrive by ship. On the contrary, deliveries from the main DC to the stores can occur within the same day if the products must be cross-docked. These lead times cannot be shortened except in the case where air cargos can be preferred by the Headquarters in Cyprus for products arriving from Hemel.

5.2.2 Order Fulfillment

The Order Fulfillment Process as mentioned in section 1.3 was split into two parts of order fulfillments for the flow of products and flow of information. Before mapping these flows in detail a bigger picture of the supply chain is presented using the Decision Point Analysis.

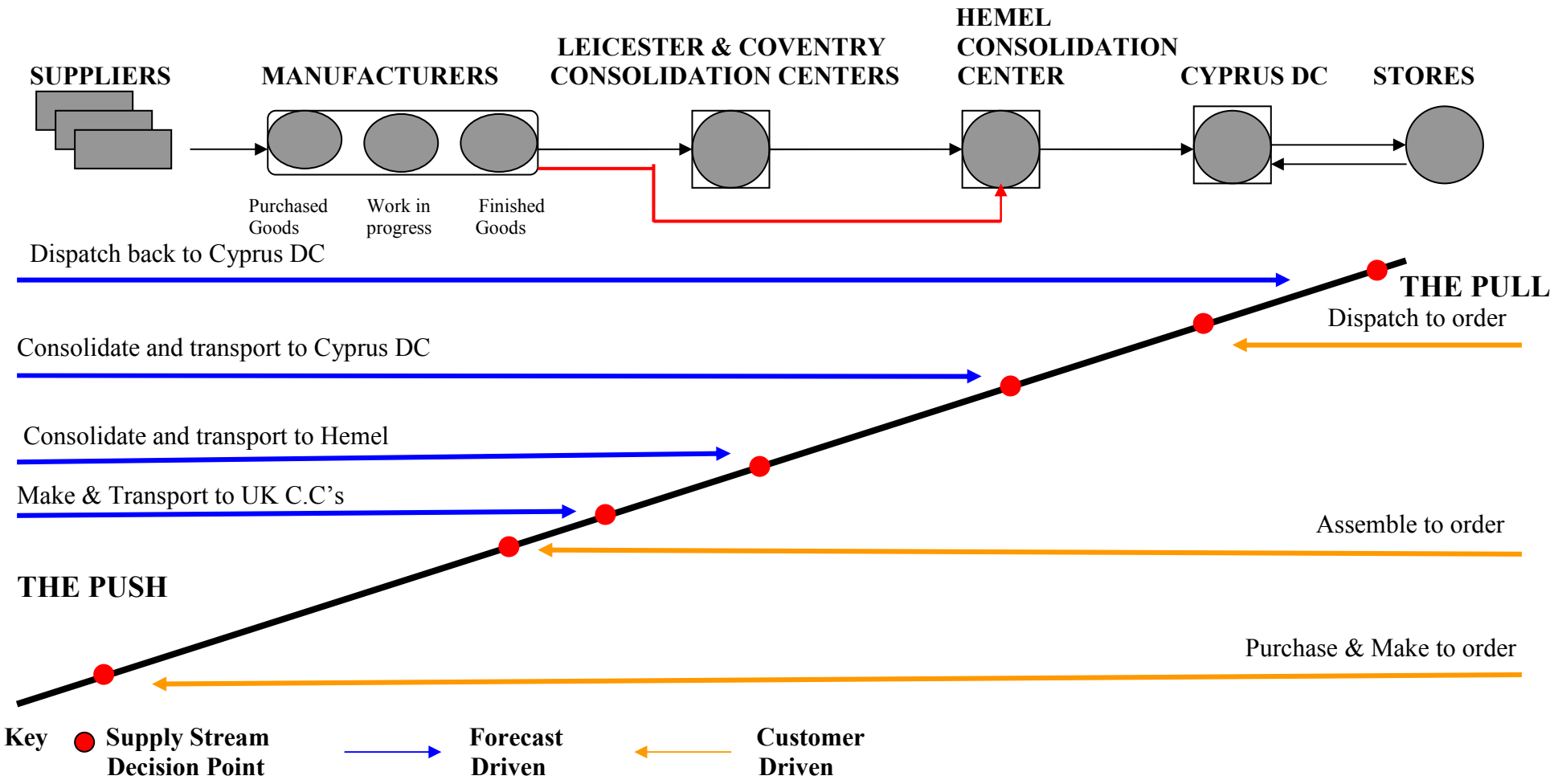
5.2.2.1 The supply chain model

The current Marks & Spencer's supply chain model is illustrated in Figure 25 with the use of the Decision Analysis mapping tool which

is explained in this section. Specifically, products are ordered as described earlier in section 5.2.1 from the company's Headquarters in Cyprus to the UK. Once the order is placed, is forwarded to a Mass Allocation System of M & S UK named "ABC". Thus, the suppliers and manufacturers are informed and they buy raw materials and produce respectively according to orders.

Then, the finished products are pushed to the next supply chain agent through two different routes: (a) Direct, where approximately 30% of volume is collected by M & S's carriers and (b) Full Service Vendor (FSV), where 70% of the volume is delivered to UK with the manufacturers' responsibility. In a case of a full load the manufacturers will "bypass" the Leicester and Coventry Consolidation Centers and from there they will be pushed directly to Hemel International. This can be seen in Table 8 highlighted with red line. In the case of part-loads the products are pushed to these two Consolidation Centers where once the products are consolidated into a full load they are pushed to Hemel International.

Figure No. 25. The Decision Point Analysis



From Hemel International the products are pushed to Cyprus' main Distribution Center. The geographical distance covered between those two locations can be seen in Appendix 7. At this point the push system stops and therefore the M & S stores in Cyprus are being serviced by the Distribution Center with a just-in-time (JIT) system. Although the products are delivered to the stores when needed, the returned products are pushed back to the Cyprus Distribution Center.

From the above explanation of the Decision Point Analysis map it can be said that all products are pushed to the main Distribution Center in Cyprus from both directions of the supply chain. This continuous push system raises the question of what is the impact in the operations in the Distribution Center in Cyprus considering the degraded technology and the inappropriate processing mentioned in section 5.1.1. This impact will be analyzed in detail in section 5.2.2.3 with the Process Activity Mapping conducted in the Distribution Center.

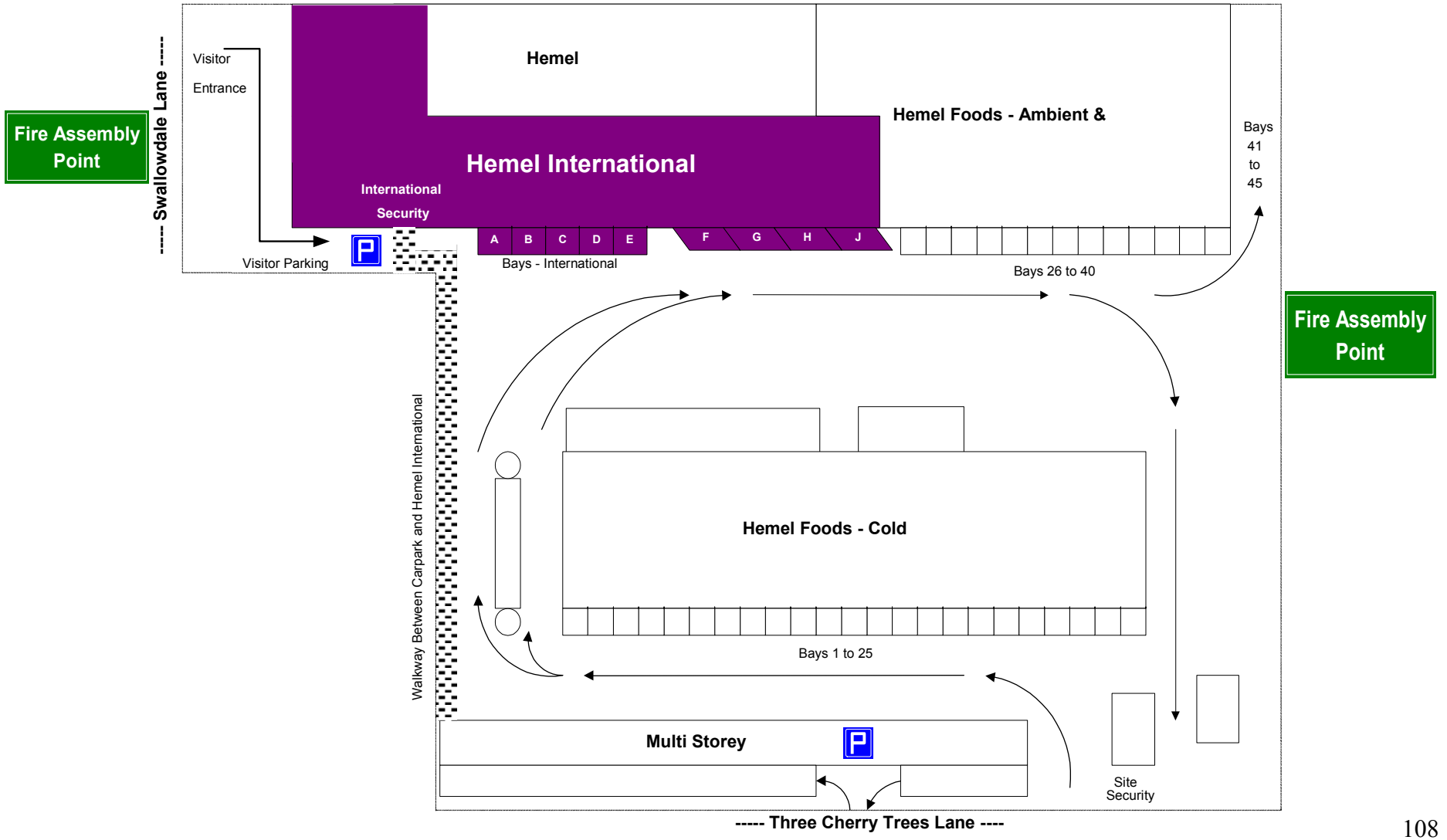
5.2.2.2 Hemel International

As stated in the assumptions in section 1.3 the Consolidation Center in Hemel was not mapped in great detail with quantitative data. However, a description of the operations there is presented and the "Big Picture" of the flow of products and flow of information was recorded with a flowchart. Only the description of the flow of hanging apparels will be presented as is the product family under investigation. All wastes during this flow were identified.

In Figure 26 the layout of Hemel International is illustrated, highlighted in purple. As can be seen, there are 9 bays-docks which are separated into two chambers. The A,B,C,D and E are the bays in the chamber for the hanging apparel (Figure 27) while bays F, G, H and J are in the chamber for boxes (Figure 28).

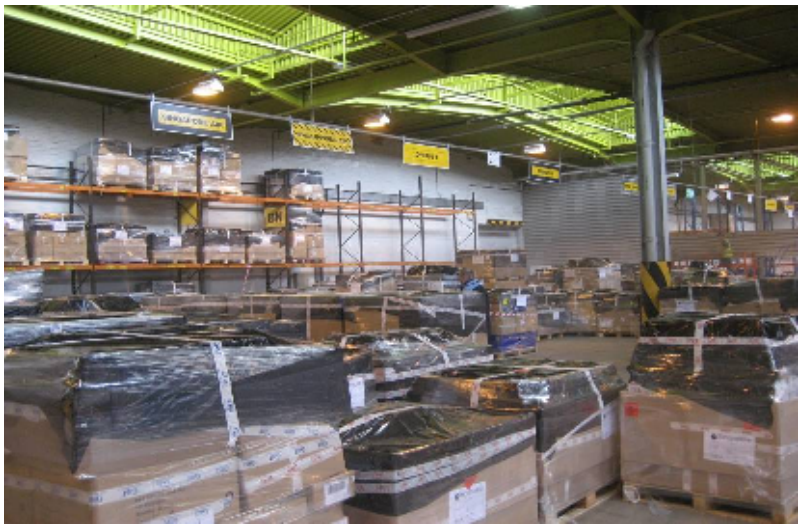
Figure No. 27.The chamber of hanging apparels.

Figure No. 26.Hemel International-Layout



Basically, the receiving bays are used as dispatching bays as well. The products are transported into the Consolidation Center from the appropriate bays according to the packaging of products (hanging or box).

Figure No. 28.The chamber with boxes.



The products arrive inside containers called "moters" of an average 10 containers per day and each moter contains 1000 URNs (Unique Reference Number). One URN is one bundle of products and informs Hemel to which countries-Accounts the products should be sent to (Figure 29). The problems identified here is that employees in Hemel, are not informed on a daily basis, about what URNs-countries are included in the container and both boxes and hanging are included which, as mentioned earlier, require different receiving bays. These problems cause delay on the processing of products as

there is no planning in advance of the space, handling and labor needed each time.

Figure No. 29.The URN.

Later on, the products are forwarded to the scanning area where they are passed into the system (Figure 31).

Figure No. 30.Receiving the hanging apparel.

By scanning the system will inform the employees whether the products should be sent to the Accounts by ship or air. The decision of how the products should be transported is taken by the different Accounts. Therefore, the products are categorized to "AIR" or "SHIP" in different sections of Hemel. The problem identified here is that the employees must tear up the nylon embracing the bundle of products and scan each hanging-apparel one by one. Moreover the identification of where a product was manufactured is done manually as the employee must tear up the nylon of the hanging-apparel and see the label on it. This manual handling of course absorbs a great amount of time considering the great volume of products that go through scanning. Since this operation is delayed in Hemel, the forwarding of the products in Cyprus 2 Account is also delayed.

Figure No. 31.Scanning the hanging apparel.

Also, the system will inform the employee of whether the products can be forwarded to the next step. If not, the screen of the computer will go amber or red and therefore this products will be tagged as "Amber" or "Red" and wait in a different section until the issues are resolved. The products become amber if the quantity, size, length and color are not as ordered by the Accounts. In this case a report will be sent to the Buyers of each Account to decide if they want the products anyway. The problem identified here is that the report which can be seen in Appendix 8 does not specify the reason that the product is amber. The lack of this information absorbs 20 minutes from each Buyer of Cyprus 2 Account and if two Buyers are with leaves this means that 40 minutes are needed for the two remaining. Each Buyer of Cyprus 2 Account receives these documents 3 times per week average.

The products will be tagged as "Red" if:

- If the composition is missing e.g. cotton, polyester.
- Delay in the supply chain (if it takes two weeks from the suppliers to deliver, there is a certain amount of time that these products automatically become red because stores reorder automatically).
- If a product cannot be scanned for any reason.
- No URN on the products to be scanned.
- If new products are not uploaded to the system.

The red products will be either sent back to the manufacturer or the issues will be resolved and the products will be forwarded. All products forwarded to the next operation are tagged as "Green". On average 15% of the volume of products are tagged as "Red" or "Amber" while the rest are being forwarded. The existence of red and amber stock is surely delaying their arrival in Cyprus 2 Account. A further investigation of the frequency of the reasons for red or amber products can inform the International Logistics Manager of M & S about the frequency of errors that each manufacturer is making. However, this data are not available for analysis and such analysis is beyond the scope of this project.

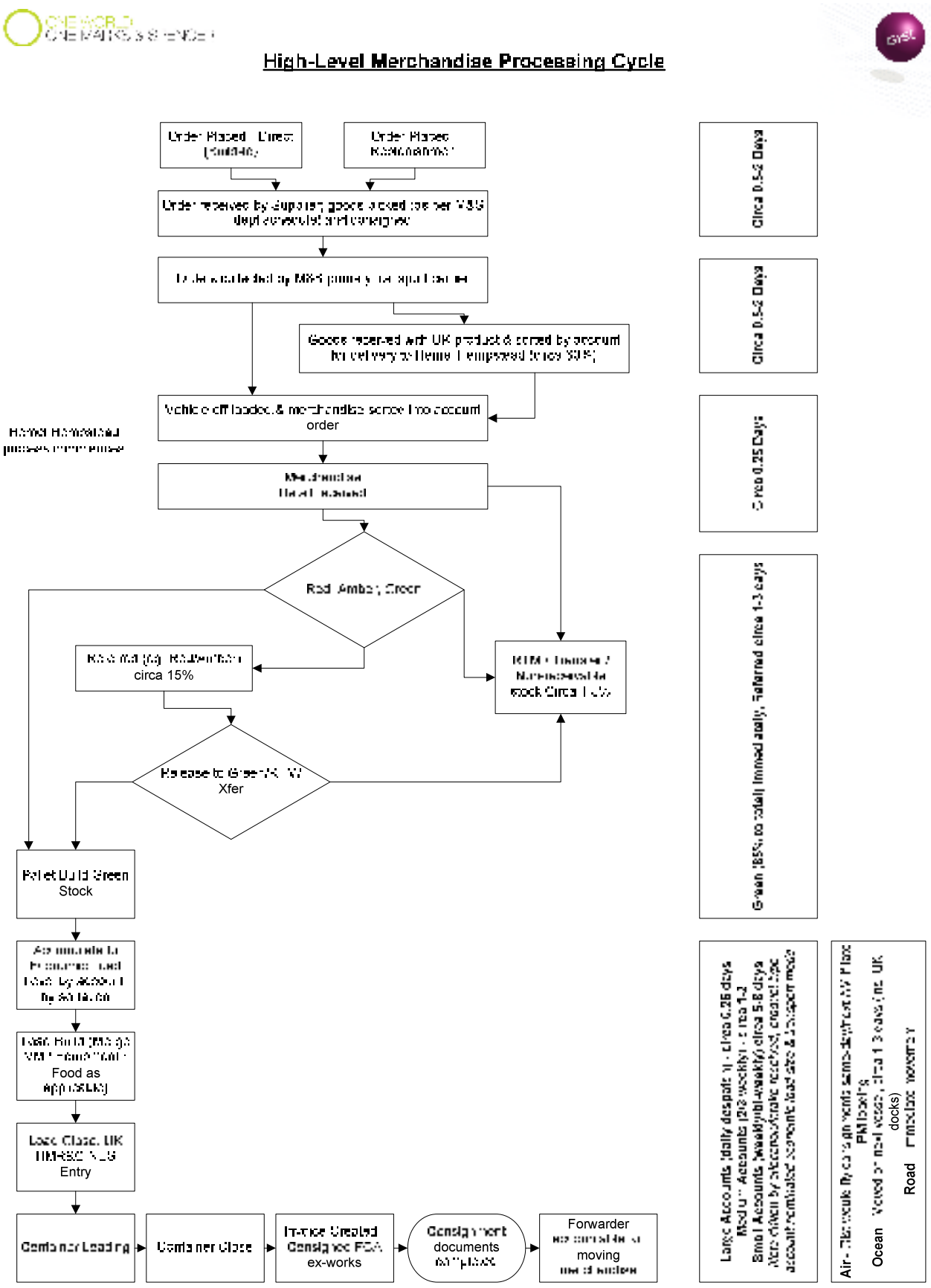
Once the products are turned into "Green" they are forwarded to the specific sections of each Account as can be seen in Figure 28. The products that must be transported by air wait there until 5-6 rails are accumulated and then forwarded to a vacuum machine where they are being compressed in order to be appropriate for air transport (Figure 32). Those products that must be transferred by ship wait until the physical loads fill a container and then they are sealed into the container and sent to the port.

Figure No. 32.The vacuum machine.

Once sealed three documents are sent to the Logistics Manager of Cyprus 2 Account: 1) The invoice note to insure the products, 2) the packing note with a description of the products included in the container and 3) the consignment note with details such as the ship's name and the container's number. The problem here is that only that moment the Logistics Manager of Cyprus 2 will be informed of what he will be expecting. Air cargos arrive within a day and ship cargos arrive within 12 days average from the moment of notice.

It is important to be noted that Hemel International has a target of clearing all stock on its floor by the end of each week. In addition, the vacuum machine is reinforcing this push system in Hemel. In Figure 33 the "Big Picture" map of the products and information flow in Hemel International as explained above is illustrated.

Figure No.33. Big picture map of information and products flow.



From the above analysis the wastes identified in Hemel are summarized in Table 13 accompanied with the impact on Cyprus 2 Account. In addition, a categorization of these wastes into value adding, necessary but non-value adding and non value adding is shown together with a statement of whether these wastes can be eliminated with a YES, MAYBE or NO response. The suggestions for eliminating the wastes that Cyprus 2 can have control of are presented in the future map in Chapter 6.

Table No. 13. The wastes in Hemel International.

Wastes	Categorization of wastes	Impact on Cyprus 2 Account	Can be eliminated?
Unclear communication-Lack of information of what products Hemel is expecting.	**Non-value adding.**	Is causing delay in arrival of products.	**Maybe.** It depends on previous level agents of the selected value stream.
Inappropriate processing-mixed containers.	**Necessary but non-value adding.**	Is causing delay in arrival of products.	**Maybe.** The mixing is done to lower supply chain costs.
Inappropriate processing-manual scanning.	**Necessary but non-value adding.**	Is causing delay in arrival of products.	**Yes**.
Inappropriate processing-manual identification of manufacturer.	**Necessary but non-value adding.**	Is causing delay in arrival of products.	**Yes.**
Defects-red and amber stock.	**Non-value adding**	Is causing at least one week delay in arrival of products.	**Yes**.
Unclear communication-Lack of information on red and amber reports.	**Non-value adding**	Is causing 1 hour delay to each Buyer of Cyprus 2 per week.	**Yes.**
Unclear communication-Lack of information in advance to the Logistics Manager of what is expected.	**Non-value adding**	Work overload to the Distribution Center in Cyprus.	**Maybe.** A load is dependent on physical structure.

5.2.2.3 The main Distribution Center in Cyprus

The mapping in the main Distribution Center was accomplished with the use of the "Big Picture Map" and the Process Activity Mapping. Each step during the flow of products within the DC was recorded and measured. The time unit used was "minutes" and the volume measurement was based on a single frame which contains 24 rails-stands of 120 hanging apparels each (Figure 34). The time for each step was recorded considering the time needed by 1 employee so that steps can be comparable. All calculations were done by timing and measuring the steps while in process.

Figure No. 34. A frame

As can be seen from the layouts in Figure 35 and Figure 36 the facility has two floors. The products can be received from the ground floor from one bay on the left side suitable for containers

Figure No. 35. The ground floor layout of the main Distribution Center.

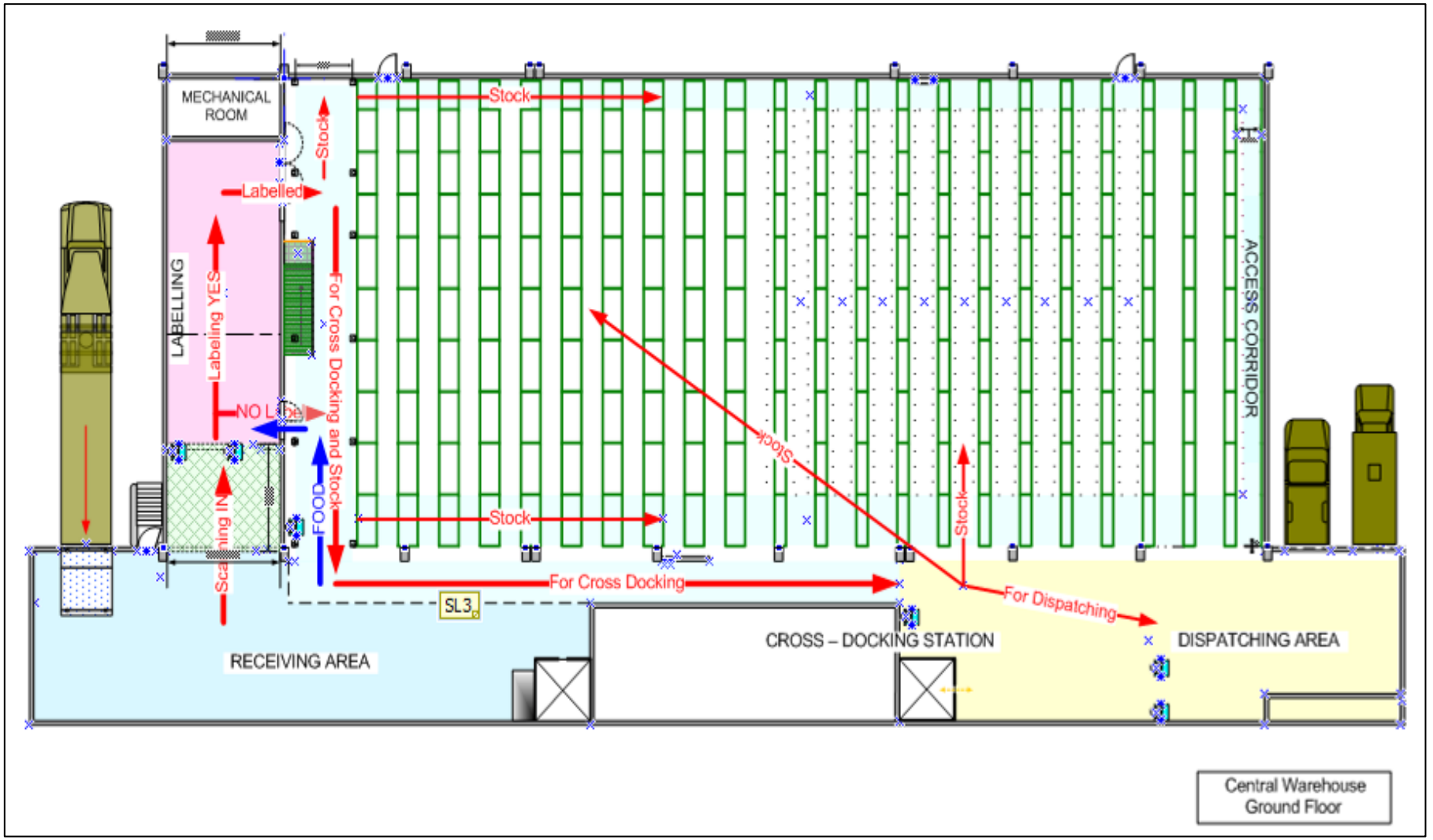
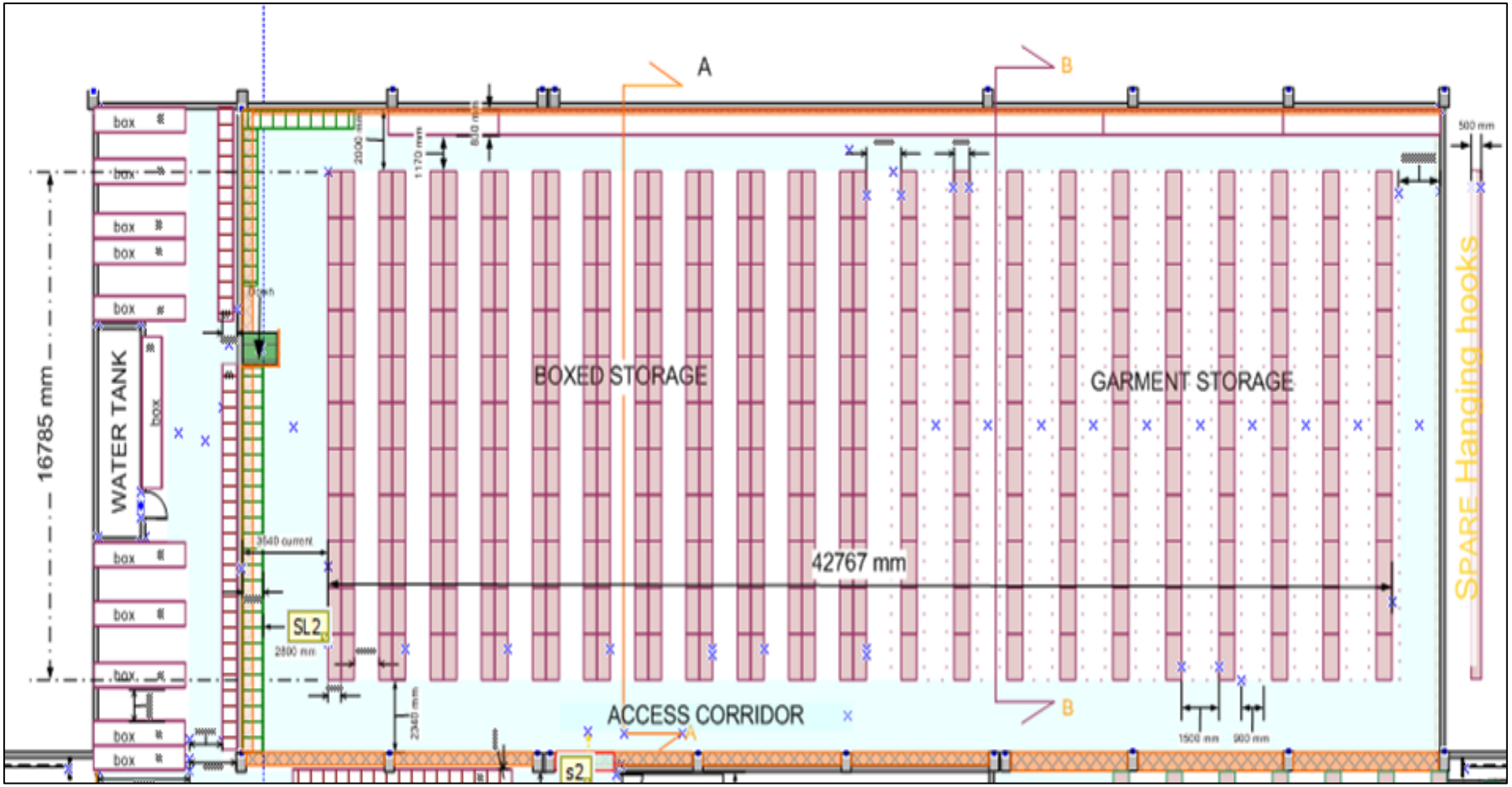


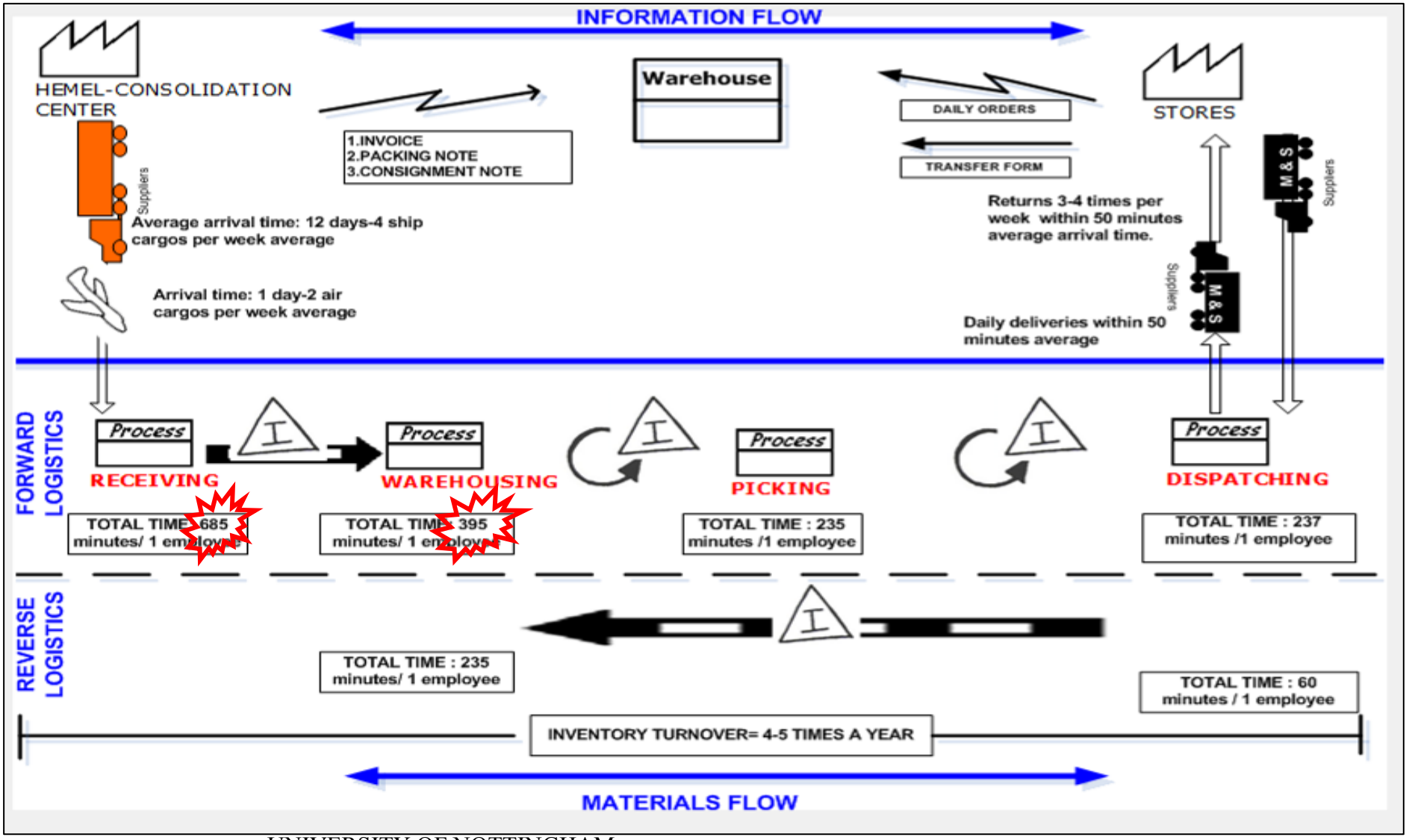
Figure No. 36. The 1st floor layout of the main Distribution Center.



and dispatched from two bays on the right side suitable for delivery vans. The two floors of the facility are both organized in the same way as they are separated into the box section on the left and the hanging-apparel section on the right. The mapping was done following the flow of a frame of products in the ground floor from receipt to dispatch.

As it can be seen from the "Big Picture Mapping" in Figure 37 the steps were categorized into four categories of steps: 1) Receiving, 2) warehousing, 3) picking and 4) dispatching. At the top half of the map there is the information flow. Specifically, at the top left side of the map the three documents (consignment note, packing list and invoice) mentioned in section 5.2.2.2 are sent electronically from Hemel to the main DC in Cyprus. At the top right side, the daily orders from the stores to the main DC are also sent electronically. This transmission is done by the ASR (Automatic Stock Replenishment) system which basically calculates automatically the appropriate quantity for each store based on a ratio prepared by the Merchandisers. So, each morning the reports are ready in the main DC for fulfillment. The transfer form given by the stores to the DC when products are returned can also be seen on the top right side.

Figure No. 37. "Big Picture Map" of the main Distribution Center



At the bottom half of the page, the flow of materials is illustrated. Products arrive within containers on average 4 times per week with ship transport within 12 days and 2 times per week with air transport within a day. Specifically, once the products arrive they are pushed from "dispatching" to the "warehousing". Then, from "warehousing" the products are pulled by the "picking" and the "dispatching". On reverse logistics the products are pushed from "dispatching" to "warehousing". The returned products arrive 3-4 times per week and the transportation time needed from stores to the main Distribution Center is 50 minutes average.

From the "Big Picture Map" it can be identified that the category "Receiving" in forward logistics and the category "Warehousing" in reverse logistics absorb a huge amount of time in comparison with the other categories in the specific flows. However, this will be explained in depth in the following analysis with Process Activity Mapping in Table 14. All numbers highlighted with red are the wastes identified which they will be explained.

First, a container arrives at the receiving bay and the frames are unloaded by a manual pallet jack to the receiving area which can be seen in Figure 38. Then, the frames are opened by tearing the nylon protecting the apparels so it can be ready for sorting it into departments, styles, sizes and colors.

Table No. 14. Process Activity Mapping of main DC-Forward Logistics

	STEPS	FLOW	TYPES OF ACTIVITIES	DISTANCE (metres)	AREA	TIME (min)	PERCENTAGE OF EACH STEP	PEOPLE
A	**RECEIVING**					685	44,1	
1	Unloading of a frame.	OPERATION	VA		Receiving	2,5	0,4	2
2	Opening of a frame.	OPERATION	VA		Receiving	2,5	0,4	4
3	Sorting of products according department, style, size and colour.	OPERATION	VA		Receiving	60	8,8	4
4	Scanning (stock-in).	INSPECTION	VA		Receiving	60	8,8	2
5	Labelling.	OPERATION	VA		Labelling	500	73,0	5
6	Products with difference in price wait for information input.	DELAY	NVA		Receiving	60	8,8	2
B	**WAREHOUSING**					395	25,5	
7	Moving products to make available space on shelves.	TRANSPORT	NNVA	20	Storage	60	15,2	5
8	Place products on shelves according to department allocation and bin location sortation.	STORAGE	NNVA		Storage	60	15,2	5
9	Walking to find products to change prices.	TRANSPORT	NVA	520	Storage	20	5,1	5
10	Getting a ladder to change prices.	TRANSPORT	NVA	350	Storage	15	3,8	5
11	Change prices.	DELAY	NVA		Storage	240	60,8	5
C	**PICKING**					235	15,1	
12	Walking from dispatching area to the garment storage and back.	TRANSPORT	NNVA	1500	Storage	60	25,5	5
13	Getting a ladder.	TRANSPORT	NNVA	350	Storage	15	6,4	5
14	Moving on the ladder up and down.	TRANSPORT	NNVA	1960	Storage	144	61,3	5
15	Picking the items.	OPERATION	VA		Storage	16	6,8	5
D	**DISPATCHING**					237	15,3	
16	Scanning (Stock transfer to stores).	INSPECTION	VA		Dispatching	36	15,2	2
17	Removal of nylon wrapping from clothes.	OPERATION	VA		Dispatching	180	75,9	3
18	Trolley covering.	OPERATION	VA		Dispatching	1	0,4	3
19	Loading of items to transport cars.	OPERATION	VA		Dispatching	20	8,4	3
	TOTAL			**4700**		**1552**	**100**	**20**
	OPERATORS							**3**

Figure No. 38. Unloading products with a manual pallet jack.

When the products are sorted then they are pushed forward for scanning in order to be passed into the system. Surprisingly, the scanning procedure is the same with the one described in Hemel as each UPC (Unique Product Code) is scanned individually (Figure 39). Later on, the products are pushed forward for labeling.

As it can be seen in Table 14 the labeling absorbs a great amount of time, specifically 73% from the whole processes in "receiving". Looking further into this matter it was discovered that the labeling includes the following activities:

1. Tear off the nylon covering the apparel to have access to price or promotional tags.
2. Remove or cover any promotional tags from UK (buy 3 get one free, reduced price etc) that are not valid in Cyprus.
3. Remove any price tags-labels in GBP.

4. **Find appropriate price from hard copy catalogues.**
5. Set the price-gun.
6. Label the product.

Activity No. 4 needs the most time from the whole set and specifically absorbs 50% of the labeling process. The reason for such a big delay is that the employees must find the appropriate price of the specific product by checking in three hard copy catalogues: a) New lines (whether is a new product), b) Current (whether is a current product) and c) Increase/decrease (whether there is a decrease or decrease in price). The increase/ decrease in products occurs due to sales season, change of seasons and when the prices with Cyprus 1 Account are agreed as mentioned in section 5.1.1.

This activity involves not only the employee who will find the price but also the employee in Headquarters who will prepare the catalogues. The employee who prepares the catalogues for the New Lines it requires a whole person's day (7.5 hours) to prepare them as it is done manually by looking in excel files for styles in departments repeatedly.

Figure No. 39.The scanning system.

Therefore, it is an "error-friendly" activity instead of user friendly absorbing a great amount of time and employees. Specifically, 25% of the 20 employees are used as it can be seen in Table 14. It is important to be stated at this point that products that are not to be sold in that season, as mentioned in section 5.2.1.1, and products whose price has not been agreed with Cyprus 1 are tagged as "STAY" while the other products are tagged as "ACTIVE". The problem here is that "STAY" products are given a "dummy" price and forwarded for storage until the actual price is agreed and labeled on them. So, these products are double touched for placing the correct price on them and of course this activity does not add any value to the customers. On the contrary, it is delaying the serviced offered by the warehouse to them.

Figure No. 40.Sorting the products.

Once the prices are labeled to products, the employees recognize, if they are alert, whether there is a great difference in prices between the UK prices and the Cypriot prices (the currency of those countries is very near). Although the currency of Cyprus changed to euro the company is forced by law to place CYP prices for some time. This difference is due to a failure of update of prices either from UK or from Headquarters in Cyprus. On average, 3 rails wait 60 minutes, every time a container arrives, until this issue is resolved.

Figure No. 41.Labeling the products.

Then, the products are forwarded to the "Warehousing" for storage according to Departments in aisles (Figure 42). Because the products are moving fast and because one stroke might not exist after a short period of time there are no specific bin locations. However, the products are placed in the hangers in an increasing order so that it would be easier for the picker to find them. As a result, the products must be moved across the aisle which is 20 meters so that new products can be placed between them on the hangers. This movement consumes 60 minutes of an employee's time and the placement consumes another 60 minutes.

As stated by the employees, the increasing SKUs (Stock Keeping Units) are occupying more space than before and they are causing

an increase in movements as well. Thus, this system is becoming very time consuming and tiring for the employees.

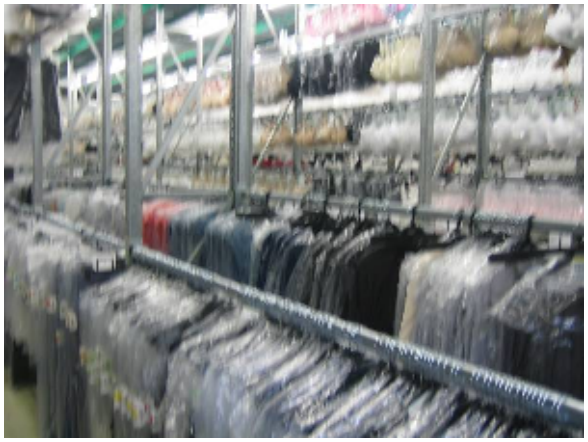
Figure No. 42. The Departments in aisles.

When the products are already on the shelves there is a change of prices not only on "Active" products but also on "Stay" products as stated earlier. This activity involves walking 520 meters within 20 minutes to find the products that need change in price, another 350 meters within 15 minutes to get a ladder and finally 240 minutes to remove old prices and place new ones. As can be seen in Figure 41 the changes in prices consume a great percentage of 60.8% in the "warehousing" category of steps.

When products must be picked, the picker follows a "Single Order Picking Strategy" where every picker is responsible for one order fulfillment at a time. However, the great disadvantage of this strategy is that the picker must walk a huge amount of space in the DC in order to fulfill an order (Frazelle, 2001). Specifically, the picker must walk 1500 meters from the dispatching area to the garment storage area and back which takes 60 minutes.

Another reason for this great movement in the picking process is because the picker does not know the specific location of the product in advance since as mentioned earlier, there are no specific locations. The picker must also walk 350 meters for 15 minutes to get a ladder. Climbing the ladder and then getting down repeatedly absorbs the greatest amount of time in the whole picking process which is 61.3% as 1960 meters are walked. In addition, this procedure does not suit the employees and therefore as Tompkins et al (2003) state this is against the ergonomic principle of material handling. The actual picking which is the activity of taking the products is only 6.8% of the process. Frazelle (2001) states that the "Single Order Picking" strategy is more suitable for orders greater than 10 line items (> 10 line items). However, the orders of the company include from one to five line items (1-5 line items).

Figure No. 43.The aisles of hanging-apparel.



Once the products are picked, they are forwarded to the dispatching area where they are being scanned so that stock ownership will be transferred to the stores. Then, a removal of the nylons protecting the apparels is being performed which although absorbs 75.9% of the "Dispatching category" it is a value added service to the stores. Last, the trolleys are covered with nylons and are loaded to the vans for transportation to the stores.

In reverse logistics the steps which can be seen in Table 15 include the unloading of the returned products and an inspection to see if the products that arrived are the correct based on a transfer form sent by the stores. This inspection consumes 66.7% of time spent in the "Dispatching" but although it is very time consuming it is necessary. The placement of products back to the hangers is similar

Table No. 15. Process Activity Mapping of main DC-Reverse Logistics

STEPS	FLOW	TYPES OF ACTIVITIES	DISTANCE	AREA	TIME	PERCENTAGE OF EACH STEP	PEOPLE
A DISPATCHING					60	20,3	
20 Unloading of returned items.	OPERATION	NNVA		Dispatching	20	33,3	1
21 Check of each item Vs the transfer form	INSPECTION	NNVA		Dispatching	40	66,7	1
B WAREHOUSING					235	79,7	
22 Walking from dispatching area to the garment storage and back.	TRANSPORT	NNVA	1920	Storage	60	25,5	1
23 Getting a ladder	TRANSPORT	NNVA	350	Storage	15	6,4	1
24 Climbing the ladder up and down.	TRANSPORT	NNVA	1950	Storage	140	59,6	
25 Placing of products back to the shelves.	OPERATION	NNVA		Storage	20	8,5	1
TOTAL			1850		295	100	20
OPERATORS							1

to the picking process and for that reason is also very time-consuming with 79.7% of the "warehousing" category of steps spent. All activities in reverse logistics are considered as necessary but non-value adding since these products are being processed twice and consume time from operations for products needed from customers.

In Table 16 all 25 steps from the Process Activity Mapping were summarized together with the types of their flow and category of activity. It can be seen that the number of necessary but non value adding activities in the DC, which are highlighted with orange, is greater than the other types with 44%. The value adding activities highlighted with green are second with 40% and non value adding which are highlighted with red are 16% of all activities.

Table No. 16.The wastes in the main Distribution Center.

STEPS	FLOW	ACTIVITIES	TRANSPORT	OPERATION	INSPECTION	STORAGE
1	OPERATION	VA		O		
2	OPERATION	VA		O		
3	OPERATION	VA		O		
4	INSPECTION	VA			I	
5	OPERATION	VA		O		
6	DELAY	NVA				S
7	TRANSPORT	NNVA	T			
8	STORAGE	NNVA				S
9	TRANSPORT	NVA	T			
10	TRANSPORT	NVA	T			
11	DELAY	NVA				S
12	TRANSPORT	NNVA	T			
13	TRANSPORT	NNVA	T			
14	TRANSPORT	NNVA	T			
15	OPERATION	VA		O		
16	INSPECTION	VA			I	
17	OPERATION	VA		O		
18	OPERATION	VA		O		
19	OPERATION	VA		O		
20	OPERATION	NNVA		O		
21	INSPECTION	NNVA			I	
22	TRANSPORT	NNVA	T			
23	TRANSPORT	NNVA	T			
24	TRANSPORT	NNVA	T			
25	OPERATION	NNVA		O		
	TOTAL		9	10	3	3
	%VA	40%				
	%NVA	16%				
	%NNVA	44%				
	%OPERATION			40%		
	%INSPECTION				12%	
	%DELAY					12%
	%TRANSPORTATION		36%			

Furthermore, it can be seen that a great amount of the flows in the DC and specifically 36% is just transportation and 12% of all the flows are unnecessarily delayed. Therefore, it is obvious that improvements in the operations of the DC are needed in order to make products flow continuously and without having personnel moving unnecessarily. To make products flow, which is one of the principles of lean analyzed in section 2.3.3, non-value adding activities must also be eliminated.

In spite of the issues spotted through the mapping tools, some other issues where also spotted while observing operations in the DC. Specifically, it was observed that within 2 weeks 20 pallets arrived by air while they were tagged as "STAY". This means that products which were not needed at that time where pushed for processing and storage in the DC by wrong decision making from Headquarters. In addition, €4100 were paid extra for choosing air transport instead of transportation by ship since a 20' container with capacity of 10 pallets cost €2700 by ship while by air it costs €6600.

Moreover, the lack of information in advance of the quantity of containers arriving and the time of their arrival created a work overload during August where most personnel was away with vacation leaves. This was more intensive when air cargos were arriving with one day lead time only. Last, it was observed that more than 80% of the space in DC was utilized. This was not unexpected considering the "STAY" products which are pushed either due to the enforcements of rules by M & S UK as mentioned in section 5.2.1.1 or due to bad decision making from Cyprus 2 Account. As Tompkins et al state "the old rule of thumb has always been that when a warehouse is utilized by more than 80%, more space is needed" (2003, p.403).

From the above analysis the wastes identified in the main Distribution Center are summarized in Table 17 accompanied with the impact on the company. In addition, a categorization of these wastes into non value adding, value adding and necessary but non-value adding is shown together with a statement of whether these wastes can be eliminated with a YES, MAYBE or NO response. The suggestions for all wastes that can be eliminated by Cyprus 2 Account are presented in the future map in Chapter 6.

Table No. 17.The wastes in the main Distribution Center.

Wastes	Categorization of wastes	Impact on Cyprus 2 Account	Can be eliminated?
Inappropriate processing- inefficient labeling	**Value adding.**	*Delay in forwarding of the products. *"Error friendly".	**Yes**.
Unnecessary Waiting- products wait for clearing out the issue with price differences.	**Necessary but non-value adding.**	*Delay in forwarding the products.	**Maybe.** It is depending on UK as well.
Unnecessary motion- moving products to make space for new arrivals.	**Necessary but non-value adding.**	*Waste of time and money. *Bad ergonomics-tiring for employees.	**Yes.**
Unnecessary motion (double handling)-walking to find products to change prices.	**Non-value adding**.	*Waste of time and money.	**Yes.**
Unnecessary motion- **(double handling)** walking to get a ladder to change prices.	**Non-value adding**	*Waste of time and money.	**Yes**.
Unnecessary motion (double handling) - change prices.	**Non-value adding**	*Waste of time and money. *Products are double touched	**Yes.**
Unnecessary motion- walking to pick products.	**Necessary but non-value adding.**	*Waste of time and money.	**Yes.**
Unnecessary motion- getting a ladder to pick products.	**Necessary but non-value adding.**	*Waste of time and money.	**Yes.**
Unnecessary motion-using the ladder repeatedly.	**Necessary but non-value adding**	*Waste of time and money. *Bad ergonomics-tiring for employees.	**Yes**.
Inappropriate processing- removing the nylons from apparels.	**Value adding.**	*Waste of time and money.	**No.**
Unnecessary inventory- early arrival of "STAY" stock and returned products.	**Non-value adding**	*Decreases space capacity. *Increases holding costs. *Makes processing of other products harder.	**Maybe**. Only those arriving due to bad decision making.
Unclear communication- lack of information in advance for stock arrivals.	**Non-value adding**	*Work overload.	**Maybe.** Technological changes needed.

5.2.2.4 The M & S stores

In order to understand any wastes within the M & S stores interviews with the stores' consultant and store managers were conducted. The stores were categorized into two types: a) big stores with multiple floors and b) small stores with only ground floor. To highlight the issues and wastes within the stores two of the 4 stores were selected, one of each type, and the activities there were mapped using again the Process Activity Mapping. The time data were recorded considering the usual quantity of stock that each store was receiving. The first store that was examined was the Acropolis which is the big store with three floors and the second store selected was the Latsia store which is a small store with only a ground floor.

As it can be seen in Tables 18 and 19 the activities are similar in both stores with differences only in the number of people being involved. The first activity is the cleaning of the store where in the Latsia store this is done by the employees who serve the customers while in Acropolis they have specialized personnel just for cleaning. The sorting of products into stories-promotion categories is another activity which occurs so that the store has a good visual appearance. The third activity is the receipt and sorting of products to the shelves once they arrive from the main DC.

Table No. 18.Process Activity Mapping at Latsia store.

	STEPS	FLOW	TYPES OF ACTIVITIES	TIME (min)	PERCENTAGE OF EACH STEP	PEOPLE
1	Cleaning	OPERATION	VA	30	5,4	3
2	Sorting of products.	OPERATION	VA	60	10,8	3
3	Receipt and sorting of products	OPERATION	VA	240	43,2	1
4	Closing cash registers	INSPECTION	VA	45	8,1	2
5	Provide feedback on Top 10	OPERATION	VA	30	5,4	4
6	Change prices.	TRANSPORT	NVA	60	10,8	1
7	Scan returned products.	INSPECTION	NVA	90	16,2	1
	TOTAL			555	100,0	4

As it can be observed from Table 18 the receipt and sorting of products is the most time-consuming with 43.2% in the Latsia store and absorbs ¼ of the total number of employees. Surprisingly, this activity is the most time-consuming in the Acropolis store as well (Table 19). Specifically, 32.4% of the time spent in all activities is consumed in this activity with ¼ of the employees occupied as well, but this percentage is smaller due to the bigger number of employees in the Acropolis store. Nevertheless, the observation in Latsia store is the same in the Acropolis store as well because the big number of employees Acropolis store is divided into different departments (men's, ladies, children's, lingerie and cosmetics, food). Therefore, the receipt of products in each department is similar to the receipts in small stores.

The problem identified here is that when the products are being received the employees occupied cannot serve the customer. However, this activity is against the value identified in section 5.1.2., which is the service offered to customers. Although employees have instructions to stop any activity and serve the customers that need help, still the service offered cannot be at 100%.

Table No. 19.Process Activity Mapping at Acropolis store.

	STEPS	FLOW	TYPES OF ACTIVITIES	TIME (min)	PERCENTAGE OF EACH STEP	PEOPLE
1	Cleaning	OPERATION	VA	60	16,2	3
2	Sorting of products.	OPERATION	VA	30	8,1	43
3	Receipt and sorting of products	OPERATION	VA	120	32,4	10
4	Closing cash registers	INSPECTION	VA	15	4,1	3
5	Provide feedback on Top 10	OPERATION	VA	60	16,2	43
6	Change prices.	TRANSPORT	NVA	60	16,2	4
7	Scan returned products.	INSPECTION	NVA	25	6,8	4
	TOTAL			370	100,0	43

Another activity is to close the cash registers where 45 minutes are needed in Latsia while just 15 minutes are needed in Acropolis due to a greater number of employees and one extra employee specialized in this activity. The fifth activity involves providing a

feedback on site of the top 10 selling products to the Merchandisers of Cyprus 2 Account.

In addition, it can be seen from Tables 18 and 19 that another activity occurring is the change of prices in both stores. This happens for the same reasons that the change of prices occurs in the main DC as explained in section 5.2.2.3. This absorbs ¼ of the total number of employees in both stores and products are double touched. As a result, 12.7% of the time in Latsia is consumed in changing the prices instead of serving the customers and 17.4 % is also spent in price changes in Acropolis instead of serving the customers. Last, the scan that is occurring in both stores for returned products is also adding no value to the customers as the time spent could have been consumed in serving the customers or in other activities than this one. This activity involves finding the products that need to be returned and scan them to remove ownership from the store. In Latsia store 16.2% of the total time is spent in this activity while in Acropolis 7.2% is being consumed.

In spite of the wastes identified with Process Activity Mapping another issue was spotted from personal observations and through the interviews in the Acropolis. Specifically, double handling and unnecessary movements in products have been observed when the layout of the stores for promotions was being prepared. The task of

preparing the image of the store which normally would take one day was in fact prepared within 3 days since new decisions kept changing the layout.

All the wastes identified in the stores are summarized in Table 20 accompanied with the impact on the company. In addition, a categorization of these wastes into non value adding, value adding and necessary but non-value adding is shown together with a statement of whether these wastes can be eliminated with a YES, MAYBE or NO response. The suggestions for all wastes that can be eliminated by Cyprus 2 Account are presented in the future map in Chapter 6.

Table No. 20.The wastes in stores.

Wastes	Categorization of wastes	Impact on Cyprus 2 Account	Can be eliminated?
Delay in service- receipt and sorting of products	**Necessary but non-value adding.**	*Lost sales.	**Yes.**
Duplication- change of prices	**Non-value adding.**	*Waste of time and money. *Lost sales.	**Yes.**
Duplication- products gathered to be scanned and sent back.	**Necessary but non-value adding.**	*Waste of time and money.	**No.** It can be reduced.
Unclear communication- continuous changes in Layouts.	**Non-value adding.**	*Unnecessary movements. *Waste of time and money.	**Yes.**

VI. FUTURE STATE MAP

In this Chapter, the future state of the Voici La Mode Ltd is illustrated. This is the "TO BE" map without the wastes identified in the current state map. Also some suggestions related to inventory management, facilities planning and communication improvements within the company are presented. These suggestions were partly based on Functional or Generic Benchmarking. According to Radhika (2002) Functional or Generic Benchmarking is used by companies to improve their processes or activities by benchmarking with other companies from different business sectors or areas of activity but involved in similar functions or work processes. Likewise in this project a Cypriot company with high, if not the highest, levels of technological implementations and advanced procedures was benchmarked. For confidentiality reasons the company's name is not mentioned here but it can be refer to as company BC (Benchmarked Company).

The elimination of wastes and all suggested actions that Voici La Mode Ltd needs to undertake to get to the future state map have been categorized into the following 4 terms:

- **Just do it: within 1 month**
- **Short term: within 3 months**
- **Medium term: within 12 months**
- **Long term: 1 year plus**

Considering the wastes presented in Tables 13, 17, 20, the issues spotted through the interviews and the questionnaire results, the following projects are suggested for implementation in Table 21. The time period of implementation of the projects is based on their importance and the time needed to be fulfilled.

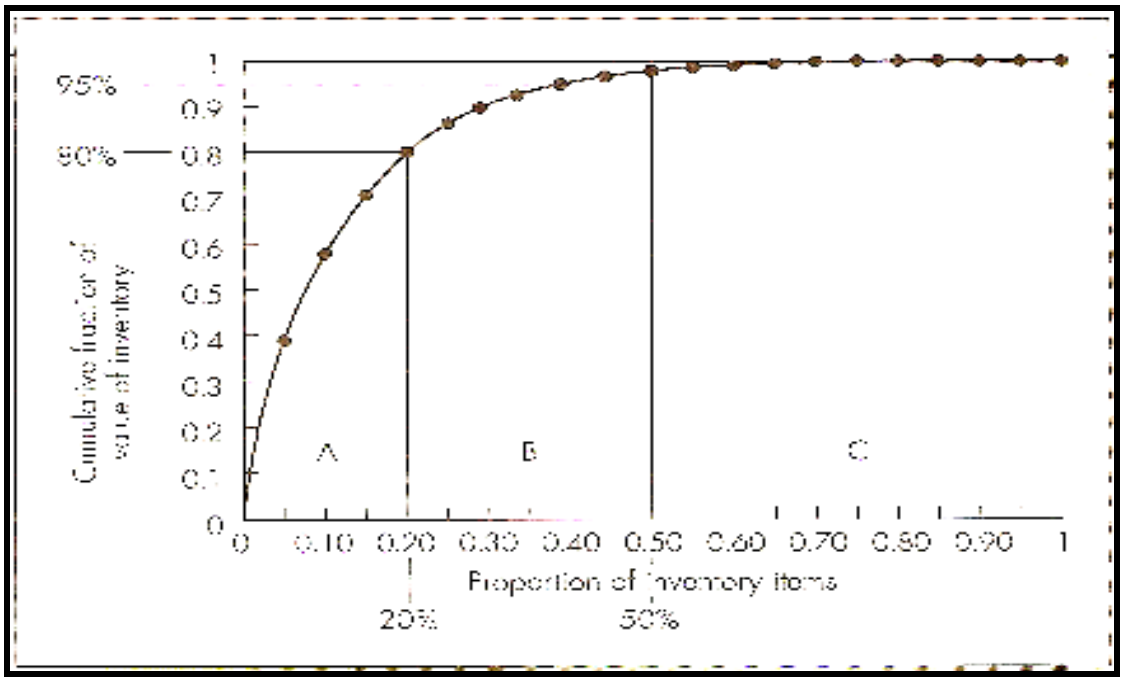
Table No. 21.Projects for future implementation.

Just do it	Short term	Medium term	Long term
ABC analysis of inventory.	Ask from IT company to provide valuable information on amber reports.	Eliminate labeling with the use of handheld scanners.	Upgrade the software database system.
Increase the number of meetings and organize their frequency according to their purpose.	Request from the International Logistics Manager analysis on the suppliers.	Rearrange the activities in the main DC.	Consider RFID a possibility of the future.
	Conduct training seminars for employees to increase the usage of e-mails and faxes.		Collaborate with the Area Manager of M & S to improve products tracking.
			Construction of a bigger and more technologically advanced DC.
			Implement CPFR (Collaborative, Planning Forecasting and Replenishment).

6.1 Just do it-within 1 month

In this category the actions that need to be taken do not require long term planning and can be implemented within the short period of 1 month. Specifically, this category includes the bad decision making which might exist often in the decisions of whether products should be transported by ship or plane. Top level managers must set strict standard procedures on this decision based on cost and arrival time needed. For example, a product that must always be available because is very fast moving it is more logical to be transported by plane. Chase et al (2007) suggest that a way to distinguish how different products should be treated is the ABC Analysis or otherwise known as Pareto Analysis. Based on euro volume as a measure of importance, the inventory items can be categorized into the following three categories: A) high euro volume, B) moderate euro volume and C) low euro volume. Products that have very low contribution might even be delisted from future orders. In Figure 44 the Pareto Analysis is illustrated. As it can be seen, category (A) represents 20% of the items and has an 80% euro volume. So, it can be said that this is more important than items of category (B) and (C).

Figure No.44.The Pareto Analysis.



Source: Nahmias (2005): Production and Operations Analysis

According to the results of statement No. 7 in Table 1 from the questionnaire given to decision makers, it can be said that reconsideration on the number of meetings should be made. More frequent meetings with all decision makers can resolve the problem of last minute changes which was supported through statement No. 5. Currently, the meetings of the company are on a monthly base but this seems that it is not enough. If the current meetings were enough then the work overload during August that was observed should not have been occurred. The operation of the new store, the agreement with Cyprus 1 Account for prices during that month and the continuous changes

in the layout preparation for stores supports further the lack of coordination between the different decision makers.

The frequent participation of every decision maker in the meetings might lead to better coordination as every decision to be made needs input from every department. The frequency of meetings might be daily and weekly as well according to the urgency of the matter to be discussed. The BC company not only does it use weekly meetings but also sudden ones for matters that require immediate attention.

6.2 Short term-within 3 months

In this category the actions that need to be taken can be implemented in the short term and specifically within 3 months. These actions are related to the lack of information on the amber reports, the existence of the red and amber stock and the least preference of decision makers in written communication means such as fax and e-mails which were presented in Table 2. Regarding the absence of helpful information on amber reports, Voici La Mode Ltd can request from the company in India that provides the IT (Information Technology) support to M & S to resolve this issue.

In addition, the inventory tagged as "amber" or "red" in Hemel can be reduced if the data from the system are analyzed in order to point out the suppliers that make the most frequent errors and the nature of these errors. Thus, recommendations can be made to these suppliers in order to reduce or even eliminate these errors. When the author requested an analysis of such data from the International Logistics Manager of M & S this was absent. However, such an analysis can be made since the International Logistics Manager was able to obtain some data from the IT (Information Technology) company for two months and provide them to the author (Appendix 10).

Last, the fact that e-mails and faxes are less preferred as means of communication can be changed through a series of training seminars for the employees. The purpose of these seminars will be to inform and convince the employees of the importance of written forms of communication in business environments. In the BC Company the usage of faxes and especially e-mails is very high. The e-mails exchanged in the BC Company are sent from different departments to all decision makers even if the content of the e-mail does not concern them directly. However, everyone in the BC Company is aware and updated of every matter that occurs.

6.3 Medium term-within 12 months

This category involves all possible activities that might be implemented within a year. As it was stated in the current state map a lot of wastes are occurring in the main Distribution Center due to manual movements and complicated procedures. One of these complexities is the labeling of products. Not only the procedure itself it is very time consuming and error friendly but also a lot of changes in prices occur. In addition the increase in SKU (Stock Keeping Units) is making this activity more time-consuming. Thus, it could be worth considering a different way to provide to the customers the price of the products. Specifically, the prices of the products can exist only in the system and the customers can scan with handheld scan guns the barcode of the product and see on the screen the price. Therefore, any updates or changes in prices can be done through the system to all products instantly without any manual labeling.

This would save up according to Table 14, 1 hour and 40 minutes (500/5) every time labeling is needed for a frame of products and will free up 25% (5/20) of the labor. In addition, according to Tables 14, 18 and 19 at least (considering only two of the stores) 2 hours and 55 minutes and 10 persons will be saved every time a change in prices will occur in the main DC and the stores.

Another, alternative is to label products manually but with a just-in-time and not with a just-in-case system. This can be achieved by rearranging the steps of activities in the main DC and specifically by placing labeling just before scanning in the "dispatching" category of steps. This means that the prices will be placed only on products needed and when needed by the stores. This rearrangement is illustrated in Table 22 where 870 meters and 4 hours and 30 minutes of savings can be identified every time a frame will flow through all the activities in the DC (4700-3830 meters, 1552-1277 minutes).

Table No. 22.Rearranging the activities in the main DC.

	STEPS	FLOW	TYPES OF ACTIVITIES	DISTANCE (metres)	AREA	TIME (min)	PERCENTAGE OF EACH STEP	PEOPLE
A	**RECEIVING**					685	53.6	
1	Unloading of a frame.	OPERATION	VA		Receiving	2,5	0,4	2
2	Opening of a frame.	OPERATION	VA		Receiving	2,5	0,4	4
3	Sorting of products according department, style, size and colour.	OPERATION	VA		Receiving	60	8,8	4
4	Scanning (stock-in).	INSPECTION	VA		Receiving	60	8,8	2
5	Labelling.	OPERATION	VA		Labelling	500	73,0	5
6	Products with difference in price wait for information input.	DELAY	NVA		Receiving	60	8,8	2
B	**WAREHOUSING**					120	9.4	
7	Moving products to make available space on shelves.	TRANSPORT	NNVA	20	Storage	60	50,0	5
8	Place products on shelves according to department allocation and bin location sortation.	STORAGE	NNVA		Storage	60	50,0	5
9								
10								
11								
C	**PICKING**					235	18.4	
12	Walking from dispatching area to the garment storage and back.	TRANSPORT	NNVA	1500	Storage	60	25,5	5
13	Getting a ladder.	TRANSPORT	NNVA	350	Storage	15	6,4	5
14	Moving on the ladder up and down.	TRANSPORT	NNVA	1960	Storage	144	61,3	5
15	Picking the items.	OPERATION	VA		Storage	16	6,8	5
D	**DISPATCHING**					237	18.6	
16	Scanning (Stock transfer to stores).	INSPECTION	VA		Dispatching	36	15,2	2
17	Removal of nylon wrapping from clothes.	OPERATION	VA		Dispatching	180	75,9	3
18	Trolley covering.	OPERATION	VA		Dispatching	1	0,4	3
19	Loading of items to transport cars.	OPERATION	VA		Dispatching	20	8,4	3
	TOTAL			3830		1277	100	20
	OPERATORS							3

With this rearrangement, all unnecessary movements of walking to find products and change their price for second time will be eliminated and products will be touched only once. Thus, the time needed in the "warehousing" category of steps dropped from 25.5 % to 9.4 % Considering that at least 35 minutes will be saved for walking and getting a ladder to change prices (Table 14) and that 227 increase/decrease reports were issued from 1 January until 11th of August 2008 this will lead to at least €480 savings for just one employee (Appendix 11). Most important though is the huge amount of time and labor needed to label all products at the same time regardless of whether they are needed in the stores at that day and even at that season.

Nevertheless, this project should be tested in order to discover possible "side effects" from the implementation of these new rearrangements. Once it is tested then the actual savings can be seen considering not only the impact of small volume changes in prices but also big ones which occur every time the prices are agreed with Cyprus 1 Account.

6.4 Long term-1 year plus

In this category the actions suggested to be taken require more than 1 year due the great amount of time needed to analyze and implement such projects. One of these projects worth considering is the upgrade of the software database (MMH) to a system capable of extracting quick data in an analyzed form. The BC Company has built its system based on its needs and the analysis of data is so high that a Business Analyst is assigned to conduct advanced analysis.

Regarding with the inappropriate processes observed in Hemel in scanning the products and identification of manufacturer a much criticized technology used first by the giant global retailer Wal-Mart can be considered for the future. This technology is the Radio Frequency Identification (RFID) which basically is a tag consisted of a microchip and an antenna placed either in a pallet or in every single product. These tags transmit data to computer systems and inform the company about the location of the products in any point in the supply chain and about its quantities (Prashanth, 2004). According to SSA Global's CEO Mike Greenough "RFID is a natural extension of bar-coding" (Ramachandran, 2005, p.7). However, RFID is justifiably a criticized technology due to its many drawbacks (Appendix 12).

Such a technology could also resolve the lack of information both in Hemel and the main DC in Cyprus about the quantity and time of arrival of products expected. Nevertheless, other methods currently used by companies are also available without the implementation of such advanced technology. The BC Company records the stock movement in the supply chain not only from the previous warehouse but also from the factory in its computer systems. The lead time from the moment an order is submitted up to the time of arrival in the port are known. Expected time for the loading of products and departure are also available to the company. In every supply chain point that the products arrive, the company is been informed. Since this problem involves not only Voici La Mode Ltd but all the supply chain agents of M & S a better organization of the supply chain is needed. However, in order to bring such a change all Accounts must cooperate and therefore Voici La Mode must collaborate with the Area Manager of M & S to improve the products' tracking.

Furthermore, to resolve the issue of false forecasting for products ordered 1 year in advance it will be worth discussing with the Area Manager the implementation of CPRF (Collaborative, Planning Forecasting and Replenishment). According to the Voluntary Inter-industry Commerce Standards (VICS) association CPRF is defined as a business practice for business partners to share forecasts and

results data through the Internet, in order to reduce inventory costs while at the same time enhancing product availability across the supply chain (Prashanth, 2004). This practice is also used by the BC Company with great success.

Last, due to the increasing number of SKUs and the increasing growth of the company a bigger Distribution Center for both Distribution Centers with more automated systems and advance technologies is worth considering. With the use of WMS (Warehouse Management Systems) to point out the position of each product to be picked and picking positions at the height of the picker will improve the ergonomics in picking and eliminate the 4700 meters of unnecessary movement every time a frame flows through the activities of the DC.

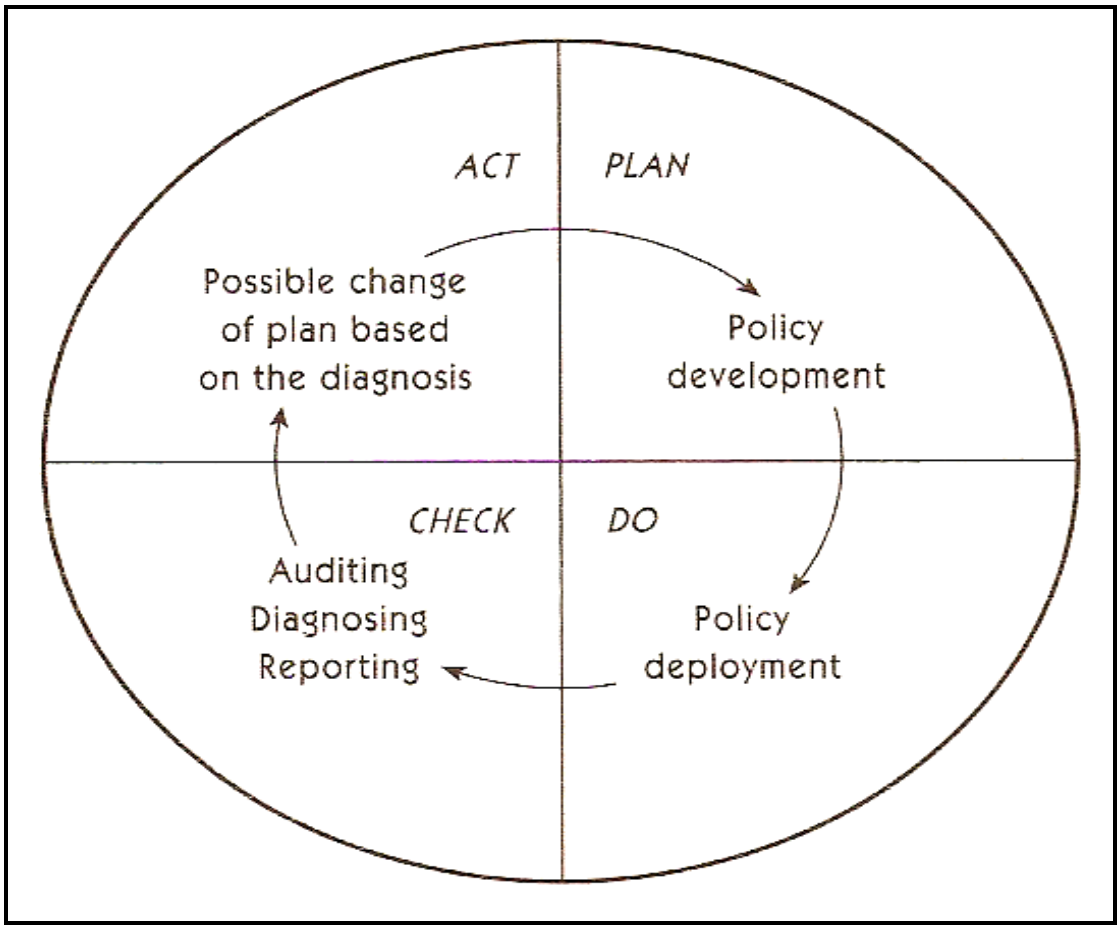
6.5 The Plan-Do-Check-Act (PDCA) cycle

All suggested projects above can be implemented with the use of the PDCA cycle. The PDCA cycle is among the most widely used tools of continuous improvement and is a four-step quality model, also known as the Deming Cycle (Anonymous, 2006). The PDCA cycle can be seen in Figure 45.

The four steps are the following:

1. **Plan**: Identify an opportunity and plan for change.
2. **Do**: Implement the change on a small scale.
3. **Check**: Use data to analyze the results of the change and determine whether it made a difference.
4. **Act:** If the change was successful, implement it on a wider scale and continuously assess the results. If the change did not work, begin the cycle again.

Figure No. 45. The PDCA cycle.



Source: Anonymous (2006): What is continuous improvement?

VII. DISCUSSION AND CONCLUSIONS

Comparing the literature related to the Value Stream Mapping technique in Chapter 2 with its implementation on the specific value stream selected, some differences were identified. Specifically, some suggested steps were not performed exactly in the same way.

First, the selection of the Value Stream Mapping tools in section 5.1.4 was not based on the VALSAT method as described in detail in section 2.10 as the employees interviewed had no previous knowledge in the VSM technique and it seemed difficult for them. Therefore, a more simplified approach was followed which was suggested by Professor Peter Hines.

Moreover, in section 2.5.6 although the need for a cross-functional team with members that represent all areas to be mapped is mentioned, this project was not conducted by a cross-functional team. However, the author kept continuous communication with members from all areas so that a complete picture of the current state can be mapped. In addition, in section 2.5.6 the need for a Value Stream Manager who understands the product's family value stream and who can help the mapper to get away from the isolated islands of functionality is also mentioned. Nevertheless, the Value Stream Manager in this project was also the mapper because although a person knew the product's family value stream, he could

not be impartial as he was in working in an area which was mapped.

In addition, a major part of the results was not extracted exclusively from the mapping tools suggested in section 2.9. These results were extracted by the interviews conducted in all areas which were mapped and from personal observations of the author.

Moreover, many limitations mentioned in section 2.12 were also found during this project. Specifically, some wastes such as the wastes of energy and human potential could not be identified with VSM. Moreover, the mapping of information was proved to be weak and for that reason the 4 Fields Mapping was added to the VSM tools. Also, many of the information gathered through the interviews were subjective as mentioned in section 2.12 and this was proven with the questionnaire results which showed that not all statements were unanimously agreed. It was also discovered that the lack of understanding in decision makers about this technique and the impact that their decision had on other members of the supply chain, delayed the implementation of this project and made difficult the search for possible solutions.

After the implementation of the Value Stream Mapping technique in this project it can be said that although this technique has its

origins in manufacturing environment it can be really implemented in warehouse and service environments as well. Although, difficulties do exist in its implementation these can be resolved.

The implementation of this technique at Voici La Mode Ltd proved to be appropriate as wastes not only in the products flow but also in the information flow were identified. The lean journey proved to be a revelation which showed improvements further than just an elimination of wastes. It set the direction for the future of Voici La Mode Ltd and hopefully it will start a new way of thinking within the company, the "Lean Thinking".

VIII. REFERENCES

Anonymous (2006), 'What is continuous improvement?', *Canadian HR Reporter*, vol. 19 (9), pp. 13.

Aft, L., Gudney, B., Kennedy, W. J., Mehta, M., Resnick, M. and Bidan, B. (2008), 'Ask the expert', *Industrial Engineer*, vol. 40 (5), pp. 55.

Ahuja I. P. S. and Khamba, J. S. (2007), 'An evaluation of TPM Implementation initiatives in an Indian manufacturing enterprise', *Journal of Quality in Maintenance,* vol. 13 (4), pp. 338-352.

Bicheno, J. (2004), *The New Lean Toolbox: Towards Fast, Flexible Flow,* Buckingham, PICSIE Books.

Bohoris, G. A., Vamvalis, C., Tracey, W. and Ignatiadou, K. (1995), 'TPM implementation in Land-Rover with the assistance of a CMMS', *Journal of Quality in Maintenance Engineering*, vol. 1 (4), pp. 3-16.

Brooks, R. (1993), 'Change for the better', *The TQM Magazine,* vol. 5 (4), pp. 51.

Chase, R., Jacobs, F. R. and Aquilano, J. N. (2007), *Operations Management for Competitive Advantage*, (11th edition), New York, McGraw-Hill.

Dale, G. B. (2003), *Managing Quality*, (4th edition), UK, Blackwell Publishing Ltd.

De Mente, B.L. (1994), Japanese Etiquette and Ethics in Business, 6th ed., NTC Business Books, Lincolnwood, IL.

Elsey, B. and Fujiwara, A. (2000), 'Kaizen and technology transfer instructors as work-based learning facilitators in overseas transplants: a case study', Journal of Workplace Learning, vol. 12 (8), pp.333-341.

Ferro, J., Jones, D. & Womack, J. (2004), *Lean Lexicon*. (2nd Edition). USA, Lean Enterprise Institute.

Fiedler, K., Galletly, J. E. and Bicheno, J. (1993), 'Expert Advice for JIT Implementation', *International Journal of Operations & Production Management, vol. 13 (6), pp. 23-30.*

Frazelle, E. H. (2001), World Class Warehousing and Material Handling, McGraw-Hill.

Gapp, R., Fisher, R. and Kobayashi, K. (2008), 'Implementing 5S within a Japanese context: an integrated management system', *Management Decision*, vol. 46 (4), pp. 565-579.

Hines, P. and Rich, N. (1997), 'The seven value stream mapping tools', *International Journal of Operations & Production Management,* vol. 17 (1), pp. 46-64.

Hines, P. and Taylor D. (2000), *'Going Lean: A guide to implementation'*, Cardiff, Lean Enterprise Research Centre.

Hines, P., Found, P., Griffiths, G. and Harrison, R. (2008), *'Staying Lean: Thriving, not just surviving',* Cardiff, Lean Enterprise Research Centre.

Hines, P., Lamming, R., Jones, D., Cousins, P. & Rich, N. (2000) *Value Stream Management,* Bolton, Northern Phototypesetting Co Ltd.

Hines, P., Rich, N., Bicheno, J., Brunt, D., Taylor, D., Butterworth, C. & Sullivan, J. (1998) 'Value stream management' *International Journal of Logistics Management,* Vol. 9(1), pp 25-43.

Hines, P., Silvi, R. and Bartolini, M. (2002), *'Lean Profit Potential'*, Cardiff, Lean Enterprise Research Centre.

Husby, P. (2007), 'Becoming Lean', *Material Handling Management*, pp. 42-45.

Jones, D., Hines, P., & Rich, N. (1997) 'Lean Logistics.' *International Journal of Physical Distribution & Logistics*, Vol. 27(3/4), pp 153-173.

Kotler, P,. & Armstrong, G,. (2004). *Principles of Marketing*. (10th Edition).New Jersey,: Pearson Prentice Hall

Liker, J. K. (2004). *The Toyota Way: 14 Principles from the Worlds' Greatest Manufacturer.* United States of America, McGraw-Hill.

Manos, T. (2006) 'Value Stream Mapping-an Introduction', Quality *Progress,* vol.39 (6), pp. 64.

Mehta, M. and Rampura, K. (2006), 'Squeezing out extra value', *Industrial Engineer*, vol. 38 (12), pp. 29.

Moinuddin, K., Collins, T. and Bansal, A. (2007) 'Process Activity Mapping-Activity based costing for semiconductor enterprises' *Cost Management,* vol. 21 (2), pp.29.

Moxham, C. and Greatbanks, R.(2001), 'Prerequisites for the implementation of the SMED methodology: A study in a textile

processing environment', *International Journal Of Quality & Reliability Management*, vol. 18 (4), pp. 404-414.

Nahmias, S. (2005), *Production and Operations Analysis,* (5th edition), New York, McGraw-Hill.

Papadopoulou, T.C. and Ozbayrak, M. (2005), 'Leanness: experiences from the journey to date', *Journal of Manufacturing Technology Management,* vol. 16 (7), pp. 784-807.

Patel, S., Shaw, P. and Dale, B. G. (2001), 'Set-up time reduction and mistake proofing methods: A study of application in a small Company', *Business Process Management*, vol. 7 (1), pp. 65-75.

Pawar, S. K., Forrester, P. and Glazzard, J. (1993), 'Value Analysis: Integrating Product-Process Design', *Integrated Manufacturing Systems,* Vol.4 (3), pp. 14-21.

Prashanth, K. (2004), 'Wal-Mart's Supply Chain Management Practices (B): Using IT/Internet to Manage the Supply Chain', *ICFAI Center for Management Research (ICMR),* pp.1-15.

Radhika, N. (2002), 'Xerox-The Benchmarking Story', *ICFAI Center for Management Research (ICMR)*, pp.1-14.

Ramachandran, A. (2005), 'US manufacturer tell us all on RFID', *Food Magazine*, pp. 6-7.

Rawabdeh, I. A. (2005), 'A model for the assessment of waste in job shop environments', *International Journal of Operations & Production Management*' vol. 25 (8), pp. 800-822.

Rother, M. and Shook, J. (1999) *Learning to see*, Mellon's Books.

Schmeidler, N., Forbes, L., Aft, L. and Mehta, M. (2007) 'Ask the expert', *Industrial Engineer,* vol. 39 (11), pp. 56.

Seth, D., Seth, N. and Goel, D. (2008), 'Application of Value Stream Mapping (VSM) for minimization of wastes in the processing side of supply chain of cottonseed oil industry in Indian context', *Journal of Manufacturing Technology Management,* vol. 19 (4), pp. 529-550.

Sohal, A. S., Keller, A. Z. and Fouad, R. H. (1988), ' A Review of Literature Relating to JIT', *International Journal of Operations & Production Management.*

Spencer, M. S., Rogers, D. S. and Daugherty, P. J. (1994), 'JIT Systems and External Logistics Suppliers', *International Journal of Operations & Production Management,* vol. 14 (6), pp. 60-74.

Stephen, J. W. and Knowles, G. (2004), 'An investigation into Japanese 5S practice in UK industry', *The TQM Magazine*, vol. 16 (5), pp. 347-353.

Strategic Direction. (2003), 'Making quality count: Is "quick and easy" kaizen the answer you have been looking for?', vol. 19 (3), pp.16-19.

Warwood J. S. and Knowles, G. (2004), 'An investigation into Japanese 5-S practice in UK industry', *The TQM Magazine,* vol. 16 (5), pp.347-353.

Wittenberg, G. (1994), '*Kaizen* – The Many Ways of Getting Better', *Assembly Automation*, vol. 14 (4), pp. 12-17.

Womack, J. (2006), 'Value Stream Mapping', *Manufacturing Engineering*, vol. 136 (5), pp. 145-156.

Womack, J. & Jones, D. (2003) *Lean Thinking.* (2nd Edition). UK, Simon & Schuster.

Womack, P. J., Jones, T. D. & Roos, D. (2007). *The Machine That Changed the World.* UK, Simon & Schuster.

Zhu, Z. and Meredith, P. H. (1995), 'Defining critical elements in JIT implementation: a survey', *Industrial Management and Data Systems,* vol. 95, (8), pp. 21-28.

IX. APPENDIXES

APPENDIX 1-Questionnaire

UNIVERSITY OF NOTTINGHAM [2007-2008]

QUESTIONNAIRE

The purpose of this questionnaire is to investigate the procedures and the communication between the employees of Voici La Mode LTD. This research is being conducted in part consideration for my degree in Supply Chain and Operations Management from the University of Nottingham. This questionnaire is anonymous and any information requested from you will be confidential.

Thank you.

1. MARK WITH A CIRCLE FROM 1-5 THE DEGREE OF USAGE OF THE FOLLOWING COMMUNICATION MEANS IN ORDER TO PERFORM YOUR ACTIVITIES WITH THE OTHER DEPARTMENTS:

(1= NOT AT ALL, 5=VERY OFTEN)

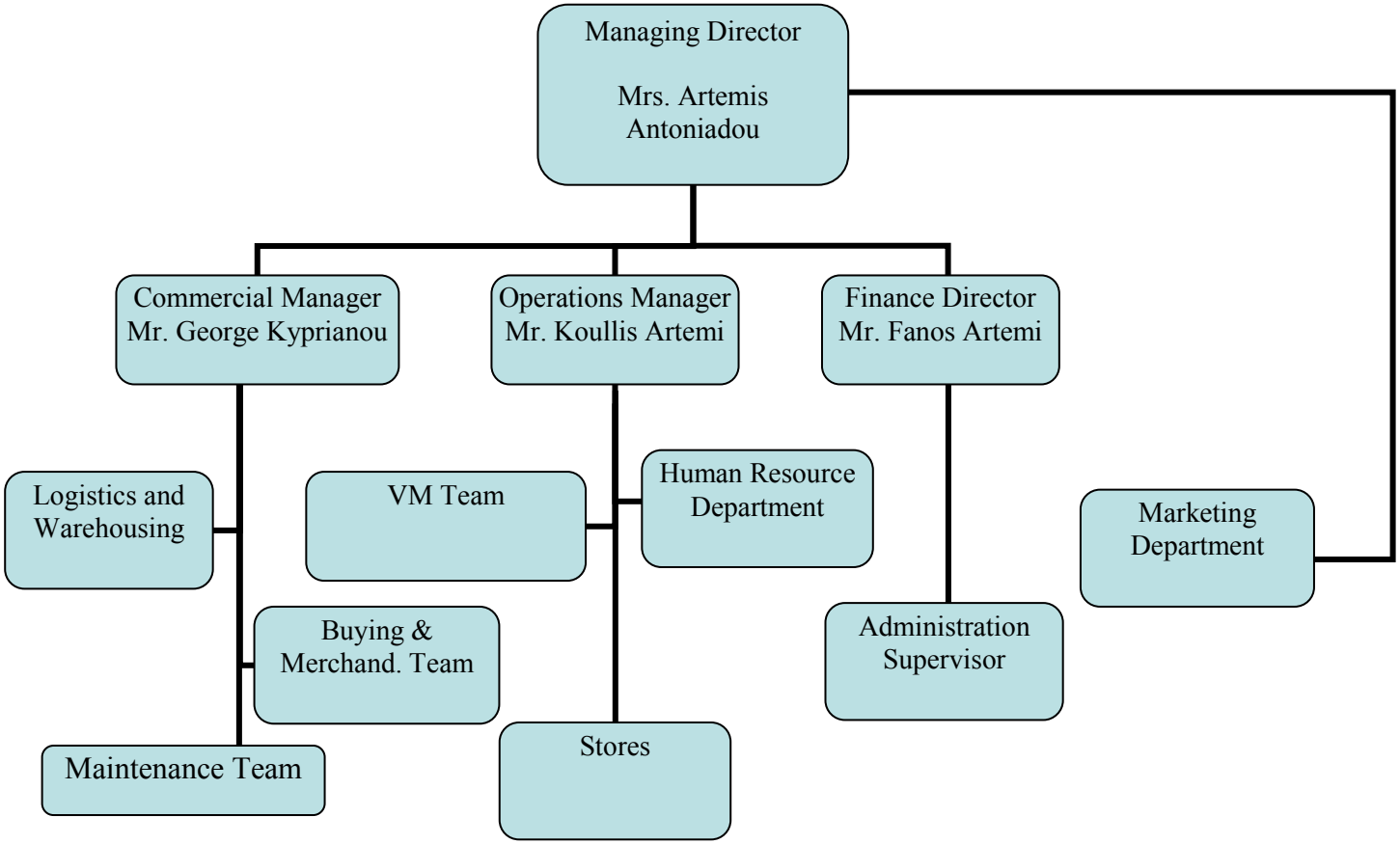
TELEPHONE	**1**	**2**	**3**	**4**	**5**
E-MAIL	**1**	**2**	**3**	**4**	**5**
FAX	**1**	**2**	**3**	**4**	**5**
MOBILE MESSAGES (SMS)	**1**	**2**	**3**	**4**	**5**
PERSONAL CONTACT	**1**	**2**	**3**	**4**	**5**
OTHER (STATE)_____	**1**	**2**	**3**	**4**	**5**

2. MARK WITH A CIRCLE FROM 1-5 THE DEGREE THAT YOU AGREE WITH THE FOLLOWING SENTENCES:

(0 =I DO NOT KNOW, 1=COMPLETELY DISAGREE, 5=COMPLETELY AGREE)

THE COMMUNICATION BETWEEN THE DIFFERENT DEPARTMENTS IS GOOD.	0	1	2	3	4	5
THERE IS GOOD COORDINATION BETWEEN THE DIFFERENT DEPARTMENTS.	**0**	**1**	**2**	**3**	**4**	**5**
THERE IS CONTINUOUS ENFORCEMENT OF THE HIERARCHY IN CASE OF A REPORT OF ANY PROBLEM.	**0**	**1**	**2**	**3**	**4**	**5**
I **DO NOT** HAVE ALL THE NECESSARY INFORMATION TO CONDUCT MY DUTIES.	**0**	**1**	**2**	**3**	**4**	**5**
THERE ARE OFTEN LAST MINUTE CHANGES.	**0**	**1**	**2**	**3**	**4**	**5**
THERE ARE PREDETERMINED PROCEDURES FOR THE REPORT OF PROBLEMS.	**0**	**1**	**2**	**3**	**4**	**5**
THE EXISTING STAFF MEETINGS ARE ENOUGH.	**0**	**1**	**2**	**3**	**4**	**5**
THERE ARE WRITTEN PROCEDURES THAT I FOLLOW IN ORDER TO PERFORM MY DUTIES.	**0**	**1**	**2**	**3**	**4**	**5**
THE TIME OF THE STAFF MEETINGS IS ENOUGH.	**0**	**1**	**2**	**3**	**4**	**5**
I AM SATISFIED WITH THE EXISTING SOFTWARE OF DATABASE (MMH).	**0**	**1**	**2**	**3**	**4**	**5**
THE EXISTING STAFF MEETINGS ARE PRODUCTIVE.	**0**	**1**	**2**	**3**	**4**	**5**
I HAVE BEEN TRAINED SATISFACTORY TO PERFORM MY DUTIES.	**0**	**1**	**2**	**3**	**4**	**5**
OTHER (STATE)_____	**0**	**1**	**2**	**3**	**4**	**5**

APPENDIX 2-Organization chart



Source: Voici La Mode Ltd

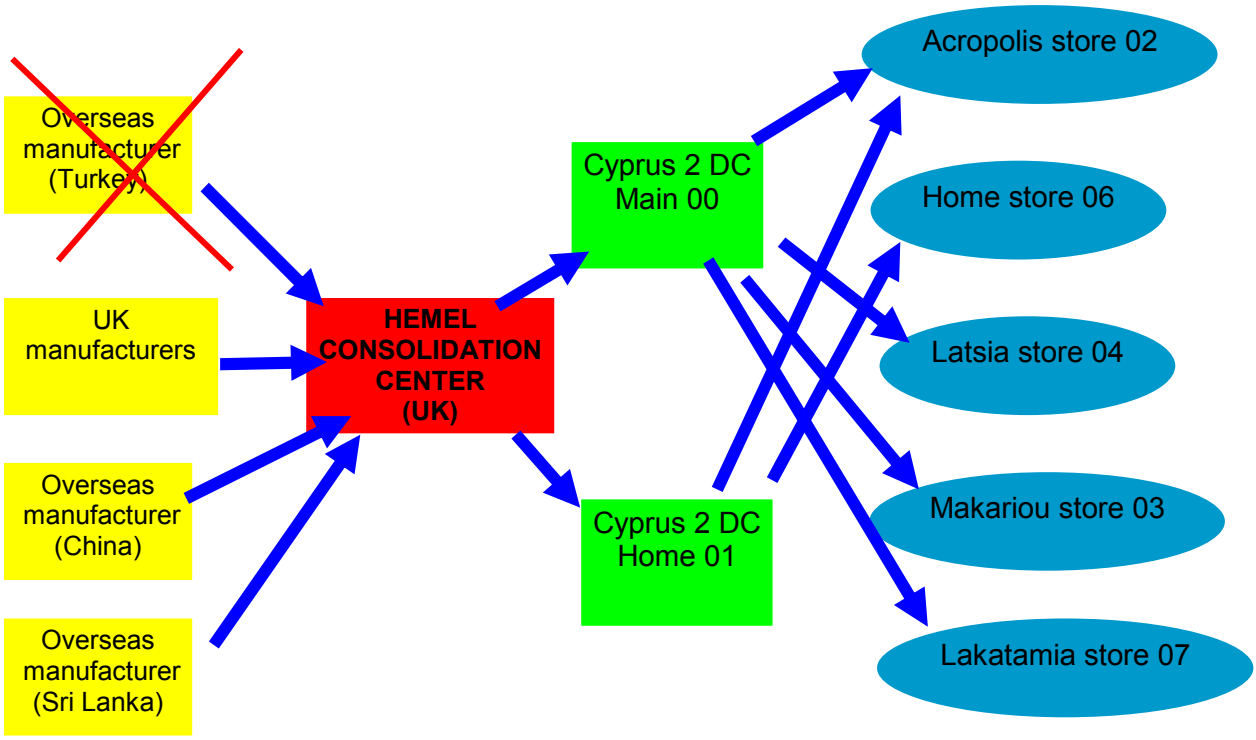
APPENDIX 3-Company's Departments

DEPT	DESCRIPTION	CATALOGUED AS
T01	LADIES ACCESSORIES	LADIES FOOTWEAR & ACCS
T02	LADIES FOOTWEAR	LADIES FOOTWEAR & ACCS
T03	MENS FOOTWEAR & SLIPPERS	MENS FOOTWEAR & ESSENTIALS
T04	CD'S	HOMEWARE
T05	FOODWEAR AND ACCESSORIES	CHILDRENS ESSENTIALS
T06	JEWELLERY & BELTS	LADIES FOOTWEAR & ACCS
T07	MENS NIGHTWEAR	MENS FOOTWEAR & ESSENTIALS
T08	LUGGAGE	HOMEWARE
T09	MENS ACCESSORIES	MENS FOOTWEAR & ESSENTIALS
T10	MENS SOCKS	MENS FOOTWEAR & ESSENTIALS
T11	MENS FORMAL SHIRTS	MENS BUSINESS
T12	MENS TIES & FORMAL ACCES.	MENS BUSINESS
T14	MENS UNDERWEAR	MENS FOOTWEAR & ESSENTIALS
T15	MENS SUITS	MENS BUSINESS
T16	MENS OUTERWEAR	MENS CASUAL
T17	MENS CASUAL TROUSERS	MENS CASUAL
T18	MENS TROUSERS	MENS BUSINESS
T19	MENS JACKETS	MENS BUSINESS
T20	TOILETRIES	LADIES BEAUTY
T21	**STATIONERY & GIFTS(T40-BOOKS)**	HOMEWARE (REP)
T22	COSMETICS & SKINCARE	LADIES BEAUTY
T25	MENS CASUAL SHIRTS	MENS CASUAL
T27	HOME ACCESSORIES	HOMEWARE (REP)
T28	MENS LEISUREWEAR	MENS CASUAL
T30	MENS KNITWEAR	MENS CASUAL
T32	SPECIALITY & SHAPEWEAR&SAPERATE	LINGERIE
T33	BRAS	LINGERIE
T34	KITCHENS	HOMEWARE (NON REPL)

T35	BEDDING	HOMEWARE (NON REPL)
T36	BATHROOMS	HOMEWARE (NON REPL)
T37	SLEEPWEAR	LINGERIE
T38	LADIES INFORMAL KNITWEAR	LADIES FORMAL
T41	LADIES CASUAL TOPS	LADIES CASUAL
T42	LADIES DRESSES	LADIES FORMAL
T43	FORMAL BLOUSES,TOPS	LADIES FORMAL
T47	SOFT FURNISHING	HOMEWARE (NON REPL)
T49	LADIES COATS & JACKETS	LADIES FORMAL
T51	LEISUREWEAR	LADIES CASUAL
T52	HOLIDAY	LADIES CASUAL
T54	LADIES CASUAL TROUSERS	LADIES CASUAL
T57	LADIES FORMAL TROUSERS & SKIRTS	LADIES FORMAL
T58	Classic Shop	LADIES FORMAL
T59	LADIES SUITS & JACKETS	LADIES FORMAL
T60	HOSIERY	LINGERIE
T61	KNICKERS & VEST	LINGERIE
T62	PER UNA	LADIES BRANDS
T64	YOUNG GIRLS ESSENTIALS	CHILDRENS ESSENTIALS
T68	ELECTRICALS	HOMEWARE
T69	LIMITED COLLECTION	LADIES BRANDS
T71	OLDER GIRLS ESSENTIALS	CHILDRENS ESSENTIALS
T72	CHILDRENS ACCESSORIES	CHILDRENS ESSENTIALS
T74	OLDER GIRLS DAYWEAR	CHILDRENS OUTWEAR
T76	SCHOOL WEAR	CHILDRENS
T77	YOUNGER GIRLS	CHILDRENS OUTWEAR
T78	BABY DAYWEAR & SLEEPWEAR	CHILDRENS OUTWEAR
T79	GIFTS & TOYS	HOMEWARE (NON REPL)
T80	LIGHTING	HOMEWARE (NON REPL)
T81	EVERYDAY COLLECTIONS	LINGERIE
T82	LADIES SLIPPERS	LADIES FOOTWEAR & ACCS
T83	LADIES BAGS & BELTS	LADIES FOOTWEAR & ACCS
T84	GARDENING	HOMEWARE (NON REPL)

T86	OLDER BOYS ESSENTIALS	CHILDRENS ESSENTIALS
T87	OLDER BOYS DAYWEAR	CHILDRENS OUTWEAR
T88	YOUNGER BOYS	CHILDRENS OUTWEAR
T94	LADIES PLUS RANGE	LADIES CASUAL
T97	PETIT	LADIES CASUAL

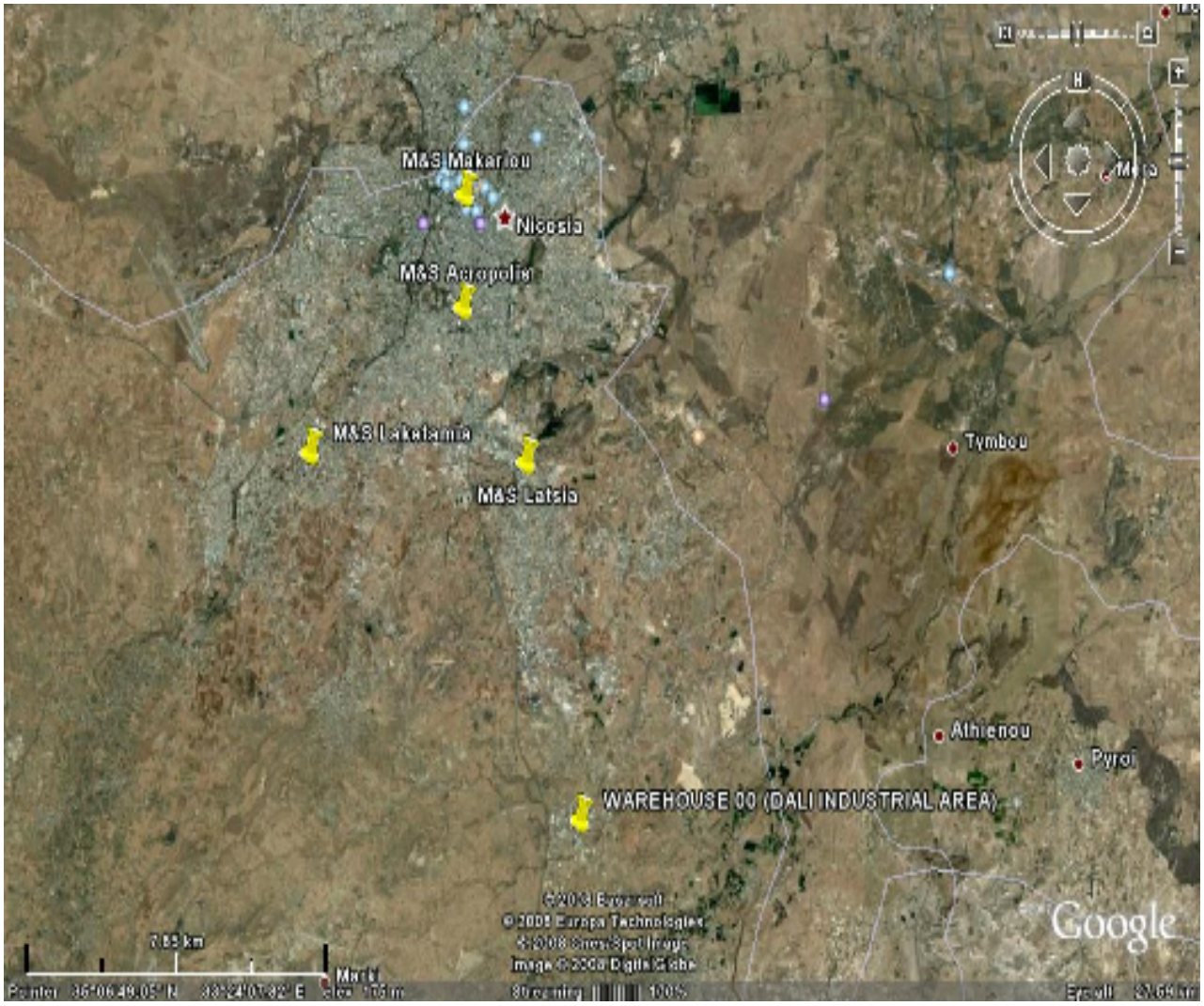
APPENDIX 4-Distribution to stores



*** Arrivals from Turkey are not allowed due to political issues.**

STORES	**PRODUCTS**
Acropolis	→ All products, some home-ware and has a Bakery
Makariou	→ All products except home-ware and small range of snacks
Latsia	→ All products except food and home-ware
Home store	→ Home-ware products only
Lakatamia	→All products except food and home-ware

APPENDIX 5-The 4 M & S stores and main DC



APPENDIX 6-Cyprus 1 & Cyprus 2 stores

APPENDIX 7-From Hemel to main DC

APPENDIX 8-The "amber" reports

Amber Stock new.txt

Amber Stock Breakdown

07 Aug 2008

For 8264 - CYP2 CYPRUS

Pk Amber	Sheet	Dept Grn	Series Red	URN Mvd	Stroke Accepted?	Col	Pri	Sec	Adv	Rcd	Shpd
291009	T33	07541	6057394190	2751	JT	42	C		3	3	0
3	0	0	0								
294010	T33	07541	6057399852	2751	JT	34	A		3	6	0
6	0	0	0	2751	Y0	34	B		3	3	0
3	0	0	0	2751	Z0	38	DD		3	3	0
3	0	0	0	7028	Z0	40	B		3	3	0
3	0	0	0	7061	JT	34	A		3	3	0
3	0	0	0								
									15	18	0
18	0	0	0								
300123	T74	09277	7469442752	2323	Y0	5-6			0	4	0
4	0	0	0								
304010	T51	08353	1008254543	6654	Y0	20	M		4	8	0
8	0	0	0								
304016	T37	08536	1008247725	4629	T0	12	L		0	10	0
10	0	0	0								
304039	T57	09636	7275577442	2313	T4	14	24		0	12	0
12	0	0	0								
311016	T14	08434	7251939994	4200C	Y0	L			80	20	0
20	0	0	0	4200C	Y0	X			20	20	0
20	0	0	0	4200C	Y0	L			0	40	0
40	0	0	7251940048								
			0						100	80	0
80	0	0	0								
314003	T76	07997	7469425151	2010R	Z0	10			18	24	0

Page 1

Amber Stock new.txt

24	0	0	0							
314007	T71	08475	1008245523	0446	E0	12-14		33	36	0
36	0	0	0	0446	E0	6-8		6	15	0
15	0	0	0	0446	E0	9-11		18	36	0
36	0	0	0							
		*						57	87	0
87	0	0	0							
	T82	09556	7275431148	5611	T1	4		60	10	0
10	0	0	0							
314008	T58	07427	2653119045	5504	SH	18	33	4	3	0
3	0	0	0	5504	SH	20	33	4	4	0
4	0	0	0	5504	SH	22	33	3	6	0
6	0	0	0	5504	SH	14	30	6	4	0
4	0	0	2653119074	5504	SH	16	30	0	9	0
9	0	0	0							
		*						17	26	0
26	0	0	0							
314009	T87	08469	7469411754	8916F	NO	5-6		0	3	0
3	0	0	0	8916F	NO	7-8		0	2	0
2	0	0	7469423881	8916F	NO	9-10		0	1	0
1	0	0	0							
		*						0	6	0
6	0	0	0							
314011	T37	09481	6039069647	3516	DI	20		0	8	0
8	0	0	0	3516	DI	20		0	6	0
6	0	0	6039069650							
		*	0					0	14	0
14	0	0	0							
314012	T51	08353	6039068062	6570	Y0	20		0	5	0
5	0	0	0							
314015	T18	07699	7409659822	2411	XB	38	31	0	4	0
4	0	0	0	2411	XB	40	31	5	8	0
8	0	0	0							
		*						5	12	0

Page 2

Amber Stock new.txt

12	0	0	0							
314017	T01	09200	1008245549	3613L	NT	1SIZE		60	90	0
90	0	0	0							
314022	T60	08794	6039063805	5198	UB	M		48	72	0
72	0	0	0							
315001	T57	08106	2653102609	2518	T4	12	36	3	3	0
3	0	0	0	2518	T4	14	36	4	3	0
3	0	0	0	2518	T4	16	36	4	7	0
7	0	0	0	2653102638	2518	T4	14	33	11	5	0
5	0	0	0	2518	T4	16	33	0	8	0
8	0	0	0							
		*						22	26	0
26	0	0	0							
321002	T64	08134	7469432908	9333S	Z0	12+3+		12	30	0
30	0	0	0							
321005	T76	08085	7469429160	5456R	Z0	6		0	12	0
12	0	0	0							
321012	T81	07656	9386014423	5543P	A4	34	B	0	20	0
20	0	0	0	5543P	A4	36	B	16	12	0
12	0	0	0	5543P	A4	38	B	4	4	0
4	0	0	0	9386014436	5543P	A4	34	C	20	20	0
20	0	0	0	5543P	A4	36	C	12	16	0
16	0	0	0	9386014449	5543P	A4	32	D	4	4	0
4	0	0	0	5543P	A4	32	DD	4	4	0
4	0	0	0	5543P	A4	34	D	8	4	0
4	0	0	0	5543P	A4	36	D	4	8	0
8	0	0	0	5543P	A4	38	C	4	4	0
4	0	0	0	5543P	A4	38	D	4	4	0
4	0	0	0							
		*						80	100	0
100	0	0	0							
321013	T14	07656	9386002943	7216C	Z0	S		16	48	0
48	0	0	0							
321018	T02	09079	6039080273	1309W	Y0	5		0	4	0

Page 3

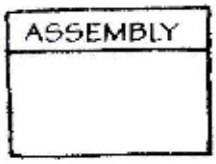
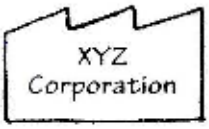
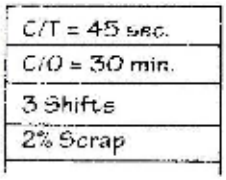
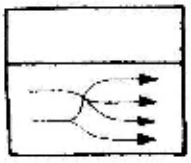
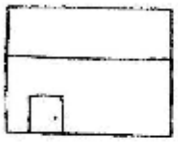
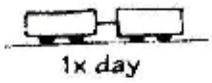
Amber Stock new.txt

4	0	0	0					0	4	0
4	0	0	0	6039080286	1309w	Y0	5	0	4	0
4	0	0	0	6039080299	1309w	Y0	5	0	4	0
4	0	0	0	6039080338	1309w	Y0	5	0	4	0
4	0	0	0	6039080341	1309w	Y0	5	0	4	0
4	0	0	0	6039080367	1309w	Y0	5	0	4	0
4	0	0	0	6039080370	1309w	Y0	5	0	4	0
4	0	0	0	6039080383	1309w	Y0	5	0	4	0
		*						0	32	0
32	0	0	0							

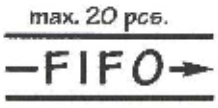
**********End Of Data**********

Page 4

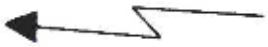
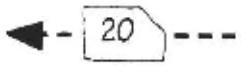
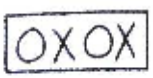
APPENDIX 9-The icons for mapping

Material Icons	Represent	Notes
	Process	One process box equals an area of flow. All processes should be labeled. Also used for departments, such as Production Control.
	Outside Sources	Used to show customers, suppliers, and outside manufacturing processes.
	Data Box	Used to record information concerning a manufacturing process, department, customer, etc.
	Cross-Dock	Materials are not stored but rather moved from in-bound trucks to shipping lanes for out-bound trucks.
	Warehouse	Materials are placed in storage locations (binned) and then picked for out-bound shipment at some later point.
	Plane Shipment	Note frequency of shipments.
	Train Shipment	Note frequency of shipments.
	Truck Shipment	Note frequency of shipments.
	Boat Shipment	Note frequency of shipments.

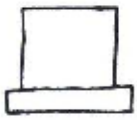
Source: Ferro et al (2004): Lean Lexicon

Material Icons	Represent	Notes
	Inventory	Count and time should be noted.
	Movement of production material by pushing.	Material that is produced and moved forward before the next process needs it; usually based on a schedule.
	Movement of finished goods to the customer.	
	Milk Run	
	Expedited Transport	
	Supermarket	A controlled inventory of parts that is used to schedule production at an upstream process. The open side faces the supplying process.
	Withdrawal	Pull of materials, usually from a supermarket.
	Transfer of controlled quantities of material between processes in a first-in, first-out sequence.	Indicates a method to limit quantity and ensure FIFO flow of material between processes. Maximum quantity should be noted.
	Buffer or Safety Stock	"Buffer" or "safety stock" must be noted.

Source: Ferro et al (2004): Lean Lexicon

Information Icons	Represent	Notes
	Manual Information Flow	For example, production or shipping schedule.
	Electronic Information Flow	For example, via electronic data interchange.
	Information	Describes an information flow.
	Production Kanban (dotted line indicates kanban path)	The "one-per-container" kanban. Card or device that tells a process how many of what can be produced and gives permission to do so.
	Withdrawal Kanban	Card or device that instructs the material handler to get and transfer parts (i.e., from a supermarket to the consuming process).
	Signal Kanban	The "one-per-batch" kanban signals when a reorder point is reached and another batch needs to be produced. Used where supplying process must produce in batches because changeovers are required.
	Kanban Post or Collection Box	Place where kanban are collected and held for conveyance.
	Kanban Arriving in Batches	
	Load Leveling	Tool to intercept batches of kanban and level the volume and mix of them over a period of time.

Source: Ferro et al (2004): Lean Lexicon

Information Icons	Represent	Notes
	Control Center	Often a computerized system such as a Material Requirements Planning system.
	Phone	Usually for expedited information.
	Orders	Often in electronic form.
General Icons		
	Operator	Represents a person viewed from above.
	Kaizen Lightning Bursts	Highlights improvement needs on a value-stream map at specific processes that are critical to achieving the value-stream vision; can be used to plan kaizen workshops.
	Go-See Scheduling	Adjusts schedules based on checking inventory levels.

Source: Ferro et al (2004): Lean Lexicon

APPENDIX 10-The form of data on "red" stock

BU	Dept	Stroke	Supplier	PK Sheet	Received Date	Refered Indicator
01	T01	0632	00046	304001	29/07/08	O
01	T01	0632	00046	304001	29/07/08	O
01	T01	0635	00046	321001	19/08/08	A
01	T01	5314C	01186	314002	07/08/08	O
01	T01	5304C	01186	314002	18/08/08	A
01	T01	5314C	01186	314002	07/08/08	O
01	T01	5304C	01186	314002	18/08/08	A
01	T01	7318	05982	341005	22/08/08	N
01	T01	7382	05982	341005	21/08/08	T
01	T01	7379	07351	341007	21/08/08	O
01	T01	7304	07761	291006	20/07/08	A
01	T01	7384	07761	291006	20/07/08	A
01	T01	3610A	08208	291010	04/08/08	A
01	T01	7790	08208	311009	31/07/08	O
01	T01	3609L	08208	314009	07/08/08	O
01	T01	5916	08242	274009	09/07/08	O
01	T01	5917	08242	274009	09/07/08	O
01	T01	5915	08242	274009	09/07/08	O
01	T01	7208A	08338	314011	13/08/08	A
01	T01	7215A	08338	331011	19/08/08	A
01	T01	3613L	09200	314017	05/08/08	O
01	T01	5918	09616	264017	01/07/08	N
01	T01	5918	09616	274015	09/07/08	N
01	T02	8729	07550	314002	15/08/08	A
01	T02	8509	07550	321002	20/08/08	A
01	T02	9006W	07550	331002	14/08/08	O
01	T02	2083	07702	331003	21/08/08	T
01	T02	2083	07702	331003	21/08/08	T
01	T02	2083	07702	331003	21/08/08	T
01	T02	2083	07702	331003	21/08/08	T
01	T02	2083	07702	331003	21/08/08	T
01	T02	5821	07702	331003	19/08/08	O
01	T02	1413	07917	271008	03/07/08	A
01	T02	8724	07917	284007	28/07/08	A
01	T02	8724	07917	284007	28/07/08	A
01	T02	6994	07917	284007	16/07/08	A
01	T02	6994	07917	284007	15/07/08	A
01	T02	6994	07917	284007	15/07/08	A
01	T02	6994	07917	284007	15/07/08	A
01	T02	6994	07917	284007	15/07/08	A
01	T02	6994	07917	284007	15/07/08	A
01	T02	6994	07917	284007	16/07/08	A
01	T02	6994	07917	284007	15/07/08	A
01	T02	6994	07917	284007	15/07/08	A
01	T02	2076A	07917	294008	21/07/08	A
01	T02	2076	07917	294008	22/07/08	A
01	T02	2076	07917	294008	22/07/08	A

01	T02	0521	07917	294008	22/07/08	A
01	T02	8727	07917	294008	23/07/08	A
01	T02	8724	07917	294008	21/07/08	A
01	T02	8724	07917	294008	21/07/08	A
01	T02	8724	07917	294008	21/07/08	A
01	T02	8724	07917	294008	21/07/08	A
01	T02	8724	07917	294008	22/07/08	A
01	T02	8724	07917	294008	21/07/08	A
01	T02	8724	07917	294008	23/07/08	A
01	T02	8724	07917	294008	21/07/08	A
01	T02	0502	07917	294008	22/07/08	A
01	T02	6994	07917	301006	29/07/08	A
01	T02	0517	07917	301006	24/07/08	O
01	T02	0521	07917	314007	14/08/08	A
01	T02	0518	07917	314007	07/08/08	O
01	T02	0519	07917	314007	08/08/08	A
01	T02	8728	07917	321007	12/08/08	O
01	T02	8162	08525	281023	10/07/08	A
01	T02	8162	08525	281023	11/07/08	A
01	T02	1309W	09079	321018	06/08/08	A
01	T02	1309W	09079	321018	07/08/08	A
01	T02	1309W	09079	321018	06/08/08	A
01	T02	1309W	09079	321018	07/08/08	A
01	T02	1309W	09079	321018	06/08/08	A
01	T02	1309W	09079	321018	06/08/08	A
01	T02	1309W	09079	321018	07/08/08	A
01	T02	1309W	09079	321018	07/08/08	A
01	T02	1309W	09079	321018	06/08/08	A
01	T02	1309W	09079	321018	06/08/08	A
01	T02	1309W	09079	321018	06/08/08	A
01	T02	1309W	09079	321018	07/08/08	A
01	T02	1309W	09079	321018	07/08/08	A
01	T02	1309W	09079	321018	07/08/08	A
01	T02	1817	09079	341011	21/08/08	N
01	T02	1817	09079	341011	22/08/08	N
01	T02	1817	09079	341011	22/08/08	N

Refererred Indicator	Description
A	Non-advised.
E	Awaiting EUR information.
L	Supplier Information required for Saudi
M	Multiple Country of origin.
N	Stroke data incomplete. Stroke status is not A or cost price or VAT indicator is missing.
O	The amount received was over the advice amount
P	Prohibited.
R	Was referred but has since gone green.
U	UPC not on file.
T	The amount received was less than the advice amount (Short)

* BU (Business Unit): Whether is men's, ladies', children's or lingerie.

APPENDIX 11-Savings from suggestions

Calculations:

Walking to find products and change prices: 20 minutes

Getting a ladder to change prices : 15 minutes

TOTAL 35 minutes

* The time needed for the actual activity of changing the prices was not taken into consideration because it was calculated for a whole frame while the increase/decrease reports refer mostly to a lower volume of products.

35 minutes x 227 reports= 7945 minutes (reports for 8 months only)

One persons' day = 450 minutes

=> 7945/450 =17.65 ≈18 person's days

=>18 x €26.67= €480 savings for just 1 employee

APPENDIX 12-RFID benefits Vs drawbacks

Radio Frequency Identification (RFID) tags: An antenna and a microchip able to store product details.

Benefits:

- Personnel could have real time access to stock position in stores and distribution centers
- Could store greater product detail than bar codes
- Less labor costs and time (no scanning in distribution centers and no inspection for stock outs in stores)
- Potential decrease in stock outs in stores
- Potential reduction in merchandise thefts at stores
- Potential reduction in stock levels

Drawbacks:

- Too expensive
- Unfamiliarity to many suppliers
- No industry standards are set
- Not compatible in some cases such as liquid cases or goods packed in metal cases
- The transmission of the RFID tag cold not work well when products are on conveyor belts (man help needed in DC to correct problem)
- Fear about privacy of consumers since shopping habits are recorded to the smallest detail